22500481216

SIR BENJAMIN BRODIE'S WORKS.

VOL. II.

LONDON
PRINTED BY SPOTTISWOODE AND CO.
NEW-STREET SQUARE

MEDAL PRESENTED TO SIR BENJAMIN BRODIE ON HIS RESIGNATION OF THE OFFICE OF SURGEON TO ST GEORGE'S HOSPITAL.

(Frontispiece for Vol 2)

54635

THE WORKS

OF

SIR BENJAMIN COLLINS BRODIE

BART. D.C.L.

SERJEANT-SURGEON TO THE QUEEN,

PRESIDENT OF THE ROYAL SOCIETY, ETC.

WITH AN AUTOBIOGRAPHY.

COLLECTED AND ARRANGED BY

CHARLES HAWKINS

FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND.

IN THREE VOLUMES.

VOL. II.

LONDON:
LONGMAN, GREEN, LONGMAN, ROBERTS, & GREEN.
1865.

-9768457

WELLCOME HISTORICAL MEDICAL LIBRARY

M16509

WELLCOME INSTITUTE LIBRARY
Coll. welMOmec
Call No. WB7 .B86 1865

CONTENTS

OF

THE SECOND VOLUME.

PAGE

Physiological Researches respecting the Influence of the Brain on the Action of the Heart, and on the Generation of Animal Heat 1
The Croonian Lecture, from The Philosophical Transactions for 1811.

Further Experiments and Observations on the Influence of the Brain on the Generation of Animal Heat 13
From The Philosophical Transactions for 1812.

Experiments and Observations on the different Modes in which Death is produced by certain Vegetable Poisons . . . 27
From The Philosophical Transactions for 1811.

Further Observations and Experiments on the Action of Poisons on the Animal System 51
From The Philosophical Transactions for 1812.

Additional Notes to the above Papers 69

Account of a Dissection of a Human Fœtus, in which the Circulation of the Blood was carried on without a Heart . . 91
From The Philosophical Transactions for 1809.

On the Influence of the Nervous System on the Action of the Muscles in general and of the Heart in particular . . 97
The Croonian Lecture, read at the Royal Society in 1813.

Experiments and Observations on the Influence of the Nerves of the Eighth Pair on the Secretions of the Stomach . 111
From The Philosophical Transactions for 1814.

Pathological and Surgical Observations on Diseases of the Joints 115

Lectures on Diseases of the Urinary Organs 387

Notes on Lithotrity 656
From The Medico-Chirurgical Transactions for 1855.

THE WORKS

OF THE LATE

SIR BENJAMIN BRODIE,

BART.

PHYSIOLOGICAL RESEARCHES, &c.

THE four following papers, which were published many years ago in the Transactions of the Royal Society, are now for the first time collected, and republished in a separate volume.

I have availed myself of the opportunity thus afforded to offer, in the form of notes, some additional observations, which appear in some instances to confirm, while in others they have led me to modify, the conclusions at which I had arrived formerly.

Having been long engaged in the duties of an arduous profession, I have not had it in my power to continue the pursuit of those physiological inquiries to which I was able to devote a considerable portion of my time during the early part of my professional life. However, whatever loss this may have occasioned to myself, it has caused no loss to the public. A part of these inquiries, at least, has been most successfully pursued by others, and especially the labours of Orfila, Christison, and Taylor have extended our knowledge of the destructive agency of poisons far beyond the limits of my original investigations.

B. C. B.—1851.

ON SOME PHYSIOLOGICAL RESEARCHES

RESPECTING THE

INFLUENCE OF THE BRAIN ON THE ACTION OF THE HEART, AND ON THE GENERATION OF ANIMAL HEAT.

The Croonian Lecture, for 1810.

From The Philosophical Transactions for 1811.

HAVING had the honour of being appointed by the President of the Royal Society to give the Croonian Lecture, I trust that the following facts and observations will be considered as tending sufficiently to promote the objects for which that Lecture was instituted. They appear to be of some interest as throwing light on the mode in which the influence of the brain is necessary to the continuance of the action of the heart; and also as showing that the integrity of the nervous system is in some way necessary to the production of animal heat.

In making experiments on animals to ascertain how far the influence of the brain is necessary to the action of the heart, I found that in an animal in which the spinal chord had been divided in the upper part of the neck, respiration was immediately suspended, while the heart still continued to contract circulating dark-coloured blood, and that, in some instances, from ten to fifteen minutes elapsed before the heart's action had entirely ceased. I further found that when the head was removed, the divided blood-vessels having been secured by a ligature, the circulation still continued, apparently unaffected by the entire separation of the brain. These experiments confirmed the observations of Mr. Cruikshank* and M. Bichat,† that the brain is not directly neces-

* Philosophical Transactions, 1795.

† Récherches Physiologiques sur la Vie et la Mort.

sary to the action of the heart, and that when the functions of the brain are destroyed, the circulation ceases only in consequence of the suspension of respiration. This led me to conclude that, if respiration were produced artificially, the heart would continue to contract for a still longer period of time after the removal of the brain. The truth of this conclusion was ascertained by the following experiment.

Exp. 1. I divided the spinal chord of a rabbit in the space between the occiput and atlas, and having made an opening into the trachea, fitted into it a tube of elastic gum, to which was connected a small pair of bellows, so constructed that the lungs might be inflated, and then allowed to empty themselves. By repeating this process once in five seconds, the lungs being each time fully inflated with fresh atmospheric air, an artificial respiration was maintained. I then secured the blood-vessels in the neck, and removed the head, by cutting through the soft parts above the ligature, and separating the occiput from the atlas. The heart continued to contract apparently with as much strength and frequency as in a living animal. I examined the blood in the different sets of vessels, and found it dark-coloured in the venæ cavæ and pulmonary artery, and of the usual florid red colour in the pulmonary veins and aorta. At the end of 25 minutes from the time of the spinal chord being divided, the action of the heart became fainter, and the experiment was put an end to.

With a view to promote the inquiry instituted by the Society for Promoting the Knowledge of Animal Chemistry respecting the influence of the nerves on the secretions,* I endeavoured to ascertain whether they continued after the influence of the brain was removed. In the commencement of the experiment I emptied the bladder of its contents by pressure. At the end of the experiment the bladder continued empty.

This experiment confirmed the expectation that the action of the heart might be made to continue after the brain was removed, but at the same time tended to show that, under these circumstances,

* Philosophical Transactions for 1809.

there was a suspension of the secretion of urine. It appeared, however, desirable that the experiment should be repeated, and it occurred to me that in repeating it, it would be well to ascertain whether, under the same circumstances, the animal heat was maintained at the natural standard.

Exp. 2. The subject of this experiment was a middle-sized dog. The temperature of the room was 63° of Fahrenheit's thermometer. By having previously secured the carotid and vertebral arteries, I was enabled to remove the head with little or no hæmorrhage. The artificial respirations were made about 24 times in a minute. The heart acted with regularity and strength.

At the end of 30 minutes from the time of the spinal chord being divided, the heart was felt through the ribs contracting 76 times in a minute.

At 35 minutes the pulse had risen to 84 in a minute.

At one hour and 30 minutes the pulse had risen to 88 in a minute.

At the end of two hours it had fallen to 70, and at the end of two hours and a half to 35 in a minute, and the artificial respiration was no longer continued.

By means of a small thermometer with an exposed bulb, I measured the animal heat at different periods.

At the end of an hour the thermometer in the rectum had fallen from 100° to 94°.

At the end of two hours, a small opening having been made in the parietes of the thorax, and the bulb of the thermometer placed in contact with the heart, the mercury fell to 86°, and half an hour afterwards in the same situation it fell to 78°.

In the beginning of the experiment I made an opening into the abdomen, and having passed a ligature round each ureter about two inches below the kidney, brought the edges of the wound in the abdomen together by means of sutures. At the end of the experiment no urine was collected in the ureters above the ligatures.

On examining the blood in the different vessels, it was found to

be of a florid red colour in the arteries, and of a dark colour in the veins, as under ordinary circumstances.

During the first hour and a half of the experiment there were constant and powerful contractions of the muscles of the trunk and extremities, so that the body of the animal was moved in a very remarkable manner on the table on which it lay, and twice there was a copious evacuation of fæces.

Exp. 3. The experiment was repeated on a rabbit. The temperature of the room was 60°. The respirations were made from 30 to 35 times in a minute. The action of the heart at first was strong and frequent: but at the end of one hour and 40 minutes the pulse had fallen to 24 in a minute.

The blood in the arteries was seen of a florid red, and that in the veins of a dark, colour.

A small opening was made in the abdominal muscles, through which the bulb of a thermometer was introduced into the abdomen, and allowed to remain among the viscera.

At the end of an hour the heat in the abdomen had fallen from 100° to 89°. At the end of an hour and forty minutes in the same situation the heat had fallen to 85°, and when the bulb of the thermometer was placed in the thorax in contact with the lungs the mercury fell to 82°.

It has been the generally received opinion that the heat of warm-blooded animals is dependent on the chemical changes produced on the blood by the air in respiration. In the two last experiments the animals cooled very rapidly, notwithstanding that the blood appeared to undergo the usual changes in the lungs, and I was therefore induced to doubt whether the above-mentioned opinion respecting the source of animal heat is altogether correct. No positive conclusions, however, could be deduced from these experiments. If animal heat depends on the changes produced on the blood by the air in respiration, its being kept up to the natural standard must depend on there being a certain quantity of air inspired, and a certain quantity of blood propelled through the lungs in a given space of time: in other words, it must bear

a relation to the fulness and frequency of the pulse, and the completeness of the respiration. It therefore became necessary to pay particular attention to these circumstances.

Exp. 4. The experiment was repeated on a dog of a small size, whose pulse was from 130 to 140 in a minute, and whose respirations, as far as I could judge, were performed from 30 to 35 times in a minute.

The temperature of the room was 63°. The heat in the rectum of the animal at the commencement of the experiment was 99°. The artificial inspirations were made to correspond as nearly as possible to the natural inspirations, both in fulness and frequency.

At 20 minutes from the time of the division of the spinal chord, the heart acted 140 times in a minute with as much strength and regularity as before: the heat in the rectum had fallen to 96½°.

At 40 minutes the pulse was still 140 in a minute: the heat in the rectum 92½°.

At 55 minutes the pulse was 112, and the heat in the rectum 90°.

At one hour and 10 minutes the pulse beat 90 in a minute, and the heat in the rectum was 88°.

At one hour and 25 minutes the pulse had fallen to 30, and the heat in the rectum to 85°. The bulb of the thermometer having been placed within the pericardium, the mercury stood at 85°, but when among the viscera of the abdomen it rose to 87½°.

During the experiment there were frequent and violent contractions of the voluntary muscles, and an hour after the experiment was begun, there was an evacuation of fæces.

Exp. 5. The experiment was repeated on a rabbit, whose respirations, as far as I could judge, were from 30 to 40 in a minute, and whose pulse varied from 130 to 140 in a minute. The temperature of the room was 57°. The heat in the rectum, at the commencement of the experiment, was 101½°. The artificial respirations were made to resemble the natural respirations as much as possible, both in fulness and frequency.

At 15 minutes from the time of the spinal chord being divided, the heat in the rectum had fallen to 98½°.

At the end of half an hour the heart was felt through the ribs, acting strongly 140 times in a minute.

At 45 minutes the pulse was still 140; the heat in the rectum was 94°.

At the end of an hour the pulse continued 140 in a minute; the heat in the rectum was 92°; among the viscera of the abdomen 94°; in the thorax, between the lungs and pericardium, 92°.

During the experiment the blood in the femoral artery was seen to be of a bright florid colour, and that in the femoral vein of a dark colour, as usual.

The rabbit voided urine at the commencement of the experiment; at the end of the experiment no urine was found in the bladder.

Exp. 6. I procured two rabbits of the same colour, but one of them was about one fifth smaller than the other. I divided the spinal chord of the larger rabbit between the occiput and atlas. Having secured the vessels in the neck, and removed the head, I kept up the circulation by means of artificial respiration as in the former experiments. The respirations were made as nearly as possible similar to natural respirations.

In 23 minutes after the spinal chord had been divided, the pulse was strong, and 130 in a minute: the bulb of the thermometer being placed among the viscera of the abdomen, the mercury stood at 96°.

At 34 minutes the pulse was 120 in a minute; the heat in the abdomen was 95°.

At the end of an hour the pulse could not be felt, but, on opening the thorax, the heart was found acting, slowly and feebly. The heat in the abdomen was 91°; and between the lobes of the right lung 88°.

During the experiment, the blood in the arteries and veins was seen to have its usual colour.

In this, therefore, as in the preceding experiments, the heat of

the animal fell rapidly, notwithstanding the continuance of the respiration. In order to ascertain whether any heat at all was generated by this process, I made the following comparative experiment. The temperature of the room being the same, I killed the smaller rabbit by dividing the spinal chord between the occiput and atlas. In consequence of the difference of size, *cæteris paribus*, the heat in this rabbit ought to diminish more rapidly than in the other; and I therefore examined its temperature at the end of 52 minutes, considering that this would be at least equivalent to examining that of the larger rabbit at the end of an hour. At 52 minutes from the time of the smaller rabbit being killed, the temperature among the viscera of the abdomen was 92°, and between the lobes of the right lung it was 91°. From this experiment, therefore, it appeared not only that no heat was generated in the rabbit, in which the circulation was maintained by artificial respiration, but that it even cooled more rapidly than the dead animal.

At the suggestion of Professor Davy, who took much interest in the inquiry, I repeated the foregoing experiment on two animals, taking pains to procure them more nearly of the same size and colour.

Exp. 7. I procured two large full grown rabbits, of the same colour, and so nearly equal in size, that no difference could be detected by the eye.

The temperature of the room was 57°, and the heat in the rectum of each rabbit previously to the experiment was $100\frac{1}{2}°$.

I divided the spinal chord in one of them, produced artificial respiration, and removed the head, after having secured the vessels in the neck. The artificial respirations were made about 35 times in a minute.

During the first hour the heart contracted 144 times in a minute.

At the end of an hour and a quarter the pulse had fallen to 136 in a minute, and it continued the same at the end of an hour and a half. At the end of an hour and 40 minutes the pulse had

fallen to 90 in a minute, and the artificial respiration was discontinued.

Half an hour after the spinal chord had been divided, the heat in the rectum had fallen to 97°.

At 45 minutes it was 95½°.

At the end of an hour the heat in the rectum was 94°.

At an hour and a quarter it was 92°.

At an hour and a half it was 91°.

At an hour and 40 minutes, the heat in the rectum was 90½°, and in the thorax, within the bag of the pericardium, it was 87½°.

The temperature of the room being the same, the second rabbit was killed by dividing the spinal chord, and the temperature was examined at corresponding periods.

Half an hour after the rabbit was killed, the heat in the rectum was 99°.

At 45 minutes it had fallen to 98°.

At the end of an hour the heat in the rectum was 96½°.

At an hour and a quarter it was 95°.

At an hour and a half it was 94°.

At an hour and 40 minutes the heat in the rectum was 93°, and within the pericardium it was 90½°.

The following table will show the comparative temperature of the two animals at corresponding periods.

Time	Rabbit with artificial Respiration		Dead Rabbit	
	Thermometer in the Rectum	Thermometer in the Pericardium	Thermometer in the Rectum	Thermometer in the Pericardium
Before the experiment	100½	. .	100½	
30 minutes	97	. .	99	
45 „	95½	. .	98	
60 „	94	. .	96½	
75 „	92	. .	95	
90 „	91	. .	94	
100 „	90½	87½	93	90½

In this experiment, the thorax, even in the dead animal, cooled

more rapidly than the abdomen. This is to be explained by the difference in the bulk of these two parts. The rabbit in which the circulation was maintained by artificial respiration, cooled more rapidly than the dead rabbit, but the difference was more perceptible in the thorax than in the rectum. This is what might have been expected, if the production of animal heat be not immediately dependent on respiration, since the cold air by which the lungs were inflated, must ncessarily have abstracted a certain quantity of heat from the whole body, and a still larger quantity from the parts with which it came into actual contact.

Still, it was plain that some animal heat might have been generated, though so small in quantity as not to counterbalance the cooling powers of the air thrown into the lungs. It is difficult or impossible to ascertain, with perfect accuracy, what effect cold air thrown into the lungs would have on the temperature of an animal under the circumstances of the last experiment, independently of any chemical action on the blood: since, if no chemical changes were produced, the circulation could not be maintained, and if the circulation ceased, the cooling properties of the air must be more confined to the thorax, and not communicated in an equal degree to the more distant parts. The following experiment, however, was instituted, as likely to afford a nearer approximation to the truth, than any other that could be devised.

Exp. 8. I procured two rabbits of the same size and colour. The temperature of the room was 64°. I killed one of them by dividing the spinal chord, and immediately, having made an opening into the left side of the thorax, I tied a ligature round the base of the heart, so as to stop the circulation. The external wound was closed by a suture. An opening was then made into the trachea, and the apparatus for artificial respiration having been fitted into it, the lungs were inflated, and then allowed to collapse as in the former experiment, about 36 times in a minute. This was continued for an hour and a half, and the temperature was examined at different periods. The temperature of the room

being the same, I killed the second rabbit in the same manner, and measured its temperature at corresponding periods. The comparative temperature of the two dead animals, under these circumstances, will be seen in the following table.

Time.	Dead Rabbit whose Lungs were Inflated		Dead Rabbit whose Lungs were not Inflated	
	Thermometer in the Rectum	Thermometer in the Thorax	Thermometer in the Rectum	Thermometer in the Thorax
Before the experiment	100	. .	100	
30 minutes	97	. .	98	
45 „	95½	. .	96	
60 „	94	. .	94½	
75 „	92½	. .	93	
90 „	91	86	91½	88½

In this last experiment, as may be seen from the above table, the difference in the temperature of the two rabbits, at the end of an hour and a half, in the rectum, was half a degree, and in the thorax 2½°; whereas, in the preceding experiment, at the end of an hour and 40 minutes, the difference in the rectum was 2½°, and in the thorax 3°. It appears, therefore, that the rabbit in which the circulation was maintained by artificial respiration, cooled more rapidly, on the whole, than the rabbit whose lungs were inflated after the circulation had ceased. The explanation is sufficiently obvious. In the last case the cold air was always applied to the same surface, but in the former it was also applied to fresh portions of blood, by the circulation of which its cooling powers were communicated to the more distant parts of the body.

I have selected the above from a great number of similar experiments, which it would be needless to detail. It is sufficient to state, that the general results were always the same; and that, whether the pulse was frequent or slow, full or small, or whether the respirations were frequent or otherwise, there was no very perceptible difference in the cooling of the animal.

From the whole it appears to me that we may deduce the following conclusions:

1. The influence of the brain is not directly necessary to the action of the heart.

2. When the brain is injured or removed, the action of the heart ceases, only because respiration is under its influence, and if under these circumstances respiration be artificially produced, the circulation will still continue.

3. When the influence of the brain is removed the secretion of urine is suspended, and no heat is generated; notwithstanding that the functions of respiration, and the circulation of the blood, continue to be performed, and the usual changes in the appearance of the blood are produced in the lungs.

4. When the air respired is colder than the natural temperature of the animal, the immediate effect of respiration may be not to generate, but even to diminish animal heat.*

* In the original publication a postscript was added to the Croonian Lecture, detailing an experiment which showed that carbonic acid was generated in considerable quantity during the respiration of a decapitated animal. This is omitted on the present occasion, the necessity for introducing it being superseded by the more exact experiments related in the following paper.

FURTHER EXPERIMENTS AND OBSERVATIONS

ON THE

INFLUENCE OF THE BRAIN ON THE GENERATION OF ANIMAL HEAT.

Communicated to the Society for promoting the Knowledge of Animal Chemistry, and by them to the Royal Society.

From The Philosophical Transactions for 1812.

In the Croonian Lecture for the year 1810, I gave an account of some experiments, which led me to conclude that the production of animal heat is very much under the influence of the nervous system. Some facts which have since fallen under my observation illustrate this subject, and seem to confirm the truth of my former conclusions.

In an animal which is under the influence of a poison that operates by disturbing the functions of the brain, in proportion as the sensibility becomes impaired, so is the power of generating heat impaired also.

If an animal be apparently dead from a poison of this description, and the circulation of the blood be afterwards maintained by means of artificial respiration, the generation of heat is found to be as completely destroyed, as if the head had been actually removed.

Under these circumstances, if the artificial respiration be kept up until the effects of the poison cease, as the animal recovers his sensibility, so does he also recover the power of generating heat; but it is not till the nervous energy is completely restored, that heat is produced in sufficient quantity to counteract the cold of the surrounding atmosphere.*

* The poison employed in this experiment should be the essential oil of almonds, or some other, the effects of which speedily subside. If the woorara

In the experiments formerly detailed, as well as in those just mentioned, I observed that the blood underwent the usual alteration of colour in the two systems of capillary vessels, while carbonic acid was evolved from the lungs at each expiration; and hence I was led to believe, that the respiratory function was performed nearly as under ordinary circumstances, and that the usual chemical changes were produced on the blood. It appeared, however, desirable to obtain some more accurate knowledge on these points, and I have therefore instituted a series of experiments, for the purpose of ascertaining the relative quantities of air consumed in breathing, by animals in a natural state, and by animals in which the brain has ceased to perform its office; and I now have the honour of communicating an account of these experiments to the Society.

It has been shown, by Messrs. Allen and Pepys,* first, that every cubic inch of carbonic acid requires exactly a cubic inch of oxygen gas for its formation; secondly, that when respiration is performed by a warm-blooded animal in atmospheric air, the nitrogen remains unaltered, and the carbonic acid exactly equals, volume for volume, the oxygen gas which disappears.

There is therefore reason to believe, that the watery vapour, which escapes with the air in expiration, is not formed from the union of hydrogen with oxygen in the lungs, but that it is exhaled from the mucous membrane of the mouth and pharynx, resembling the watery exhalation which takes place from the peritonæum, and other membranous surfaces, when exposed; and this conclusion appears to be confirmed by the experiments of M. Magendie, lately communicated to the National Institute of Paris.

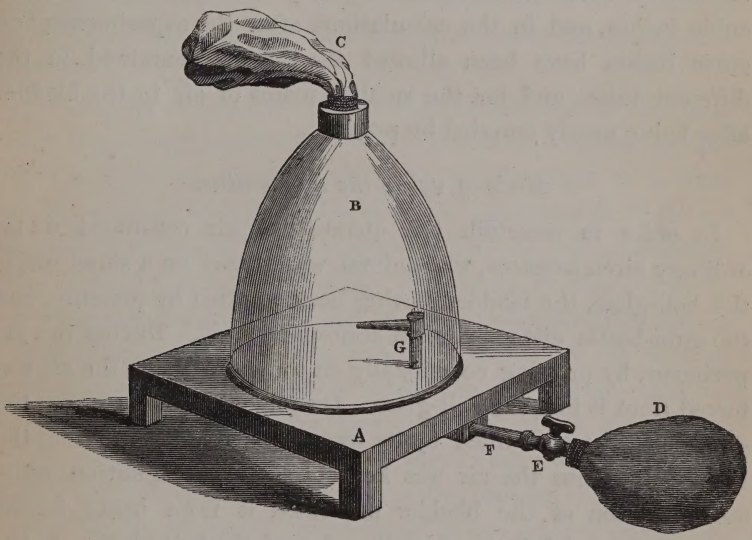
These circumstances are of importance in the present communication, which they render more simple, as they show, that in order to ascertain the changes produced on the air in respiration, it is

be employed, so long a time elapses before the poison ceases to exert its influence, that it becomes necessary that the experiment should be made in a high temperature, otherwise the great loss of heat which takes place, is sufficient to prevent recovery.

* Philosophical Transactions, 1807, 1808, 1809.

only necessary to determine the quantity of carbonic acid given out from the lungs. This becomes an exact measure of the oxygen consumed; and the nitrogen of the air and the watery vapour expired need not be taken into the account.

For the purpose of examining the changes produced on the air, by animals breathing under the different circumstances above mentioned, I contrived an apparatus, which, although simple in its structure, has been found very well to answer the intended purpose. It is represented in the accompanying plate, by referring to which the construction and application of it will be easily understood.



Description of the Apparatus.—A is a wooden stand, in which is a circular groove, three-fourths of an inch in depth, and the same in width.

B is a bell-glass, the rim of which is received in the circular groove of the wooden stand. In the upper part of the bell-glass is an opening, admitting a tube connected with the bladder C.

D is a bottle of elastic gum, having a brass stop-cock, E, connected with it.

F is a silver tube, of which one end is adapted to receive the

tube of the stop-cock E, while the other extremity, making a right angle with the rest of the tube, passes through a hole in the wooden stand, and projects into the cavity of the bell-glass, where it makes a second turn, also at a right angle, and becomes of a smaller diameter. In the upright part of the tube is an opening G.

The tubes are made perfectly air-tight, where connected with each other and with the rest of the apparatus, and the circular groove is filled with quicksilver.

The capacity of the bell-glass, allowance being made for the rim, which is received in the groove with the quicksilver, is found to be 502 cubic inches. The capacity of the gum-bottle is 52 cubic inches, and in the calculations after the experiments, two cubic inches have been allowed for the air contained in the different tubes, and for the small remains of air in the bladder after being nearly emptied by pressure.

Mode of using the Apparatus.

In order to ascertain the quantity of air consumed under ordinary circumstances, the animal was placed on a stand under the bell-glass, the bladder having been emptied by pressure, and the gum-bottle distended with atmospheric air. During the experiment, by pressing occasionally on the gum-bottle, the air was forced from it into the bell-glass. On removing the pressure, the gum-bottle became filled by its own elasticity with air from the bell-glass. Thus the air was kept in a state of agitation, while the dilatation of the bladder prevented it from being forced through the quicksilver under the edge of the bell-glass. At the end of the experiment, the gum-bottle was completely emptied by pressure, and allowed to be again filled with air from the bell-glass. This was repeated two or three times, and the air in the bottle was then preserved for examination. The proportion of carbonic acid having been ascertained, and the capacities of the different parts of the apparatus, and the space occupied by the animal being known, the total quantity of carbonic acid formed, and consequently of oxygen consumed, was easily estimated.

When the experiment was made on an animal in whom the functions of the brain were destroyed, and in whom therefore voluntary respiration had ceased, the narrow extremity of the tube was inserted into an artificial opening in the trachea, and the animal being placed under the bell-glass, the lungs were inflated at regular intervals, by means of pressure made on the gum-bottle. The tube being smaller than the trachea, the greater portion of the air in expiration escaped by the side of the tube into the general cavity of the bell-glass, while the gum-bottle filled itself by its own elasticity with air through the opening G. At the end of the experiment, a portion of air was preserved for examination, and the quantity of carbonic acid was estimated in the way already described.

The animals employed in these experiments were of the same species, and nearly of the same size. Attention to these circumstances was judged necessary, that the results might be as little liable to error as possible. The chemical examination of the air was made by agitating it in a graduated measure over quicksilver, with a watery solution of potash. My friend Professor Brande gave me his assistance in this part of the present investigation, as he had done in many of my former experiments. It will be observed, that in estimating the proportion of carbonic acid, no allowance has been made for that contained in the atmospheric air; first, because the quantity is so small that the omission can occasion no material error; and, secondly, because the object was to ascertain, not so much the absolute, as the relative quantities, of carbonic acid evolved by animals breathing under different circumstances.

The experiments which I shall first notice were made on the respiration of animals in a natural state.

Exp. 1. Thermometer 65°, barometer not noted.

A young rabbit was allowed to remain under the bell-glass during 30 minutes. The respired air at the end of this time was found to contain $\frac{1}{20}$ of carbonic acid.

It was ascertained that the rabbit occupied the space of 50 cubic inches.

The capacity of the bell-glass = 502 cubic inches.

That of the gum bottle = 52 cubic inches.

The air in the tubes and bladder = 2 cubic inches.

Then $\frac{502+52+2-50}{20}-\frac{506}{20}=25{\cdot}3$. The rabbit, therefore, in 30 minutes gave out 25·3 cubic inches of carbonic acid, and consumed the same quantity of oxygen gas, which is at the rate of 50·6 cubic inches in an hour.

Exp. 2. Thermometer 65°, barometer 30·1 inch.

A somewhat smaller rabbit was allowed to remain under the bell-glass during 30 minutes. The respired air contained $\frac{1}{18}$ of carbonic acid. The animal occupied the space of 48 cubic inches.

$$\frac{502+52+2-48}{18}=\frac{508}{18}=28{\cdot}22.$$

The carbonic acid evolved was therefore equal to 28·22 cubic inches in half an hour, which is at the rate of 56·44 cubic inches in an hour.

Exp. 3. Thermometer 64°, barometer 30·2 inch.

A young rabbit, occupying the space of 48 cubic inches, was allowed to remain under the bell-glass during the same period as in the two former instances. The respired air contained $\frac{1}{18}$ of carbonic acid.

$$\frac{502+52+2-48}{18}=\frac{508}{18}=28{\cdot}22.$$

The results of this were therefore precisely the same as those of the last experiment.

These experiments were made with great care. The animals did not appear to suffer any inconvenience from their confinement, and their temperature was unaltered.

The next order of experiments was instituted for the purpose of ascertaining the quantity of air consumed by animals in which the circulation of the blood was kept up by means of artificial respiration, after the brain had ceased to perform its functions.

Exp. 4. Thermometer 65°, barometer not noted.

Having procured two rabbits of the same size and colour, I divided the spinal chord in the upper part of the neck of one of them. An opening was made in the trachea, and the lungs were inflated at first by means of a small pair of bellows. Two ligatures were passed round the neck, one in the upper, and the other in the lower part, behind the trachea. The ligatures were drawn tight, including everything but the trachea; and the nerves, vessels, and other soft parts between them were divided with a bistoury. Eight minutes after the division of the spinal chord, the thermometer in the rectum had sunk to 97°. The animal was placed under a bell-glass, and the lungs were inflated by pressing on the gum-bottle about 50 times in a minute. When this process had been continued for 30 minutes, a portion of air was abstracted from the bell-glass, and preserved for examination. The heart was found acting regularly, but slowly; the thermometer in the rectum had fallen to 90°.

The second rabbit was killed by dividing the spinal chord about the same time when the experiment was begun on the first rabbit. Being in the same temperature, the time was noted when the thermometer in the rectum had fallen to 97°, and it was placed under another bell-glass, that it might be as nearly as possible under the same circumstances as the first rabbit. At the end of 30 minutes, the thermometer in the rectum had fallen from 97° to 91°.*

The air respired by the first rabbit contained $\frac{1}{25}$ of carbonic acid. The bulk of the rabbit was found = 50 cubic inches.

$$\frac{502+52+2-50}{25}=\frac{506}{25}=20{\cdot}24.$$

20·24 cubic inches of carbonic acid were therefore extricated in 30 minutes, which is at the rate of 40·48 cubic inches in an hour.

The carbonic acid given out in the same space of time was

* In measuring the heat of the rectum in these experiments, care is necessary that the thermometer should always be introduced to exactly the same distance from the external parts, otherwise no positive conclusion can be drawn relative to the loss of heat, as the more internal parts retain their heat longer than the superficial.

less than in the former experiments; but it is to be observed, first, that in consequence of the ligatures, the extent of the circulation was diminished; secondly, that in this instance one of the ligatures accidentally slipped, and an ounce of blood was lost in the beginning of the experiment.

As it was desirable to avoid any circumstances which might occasion a difference in the results, in the subsequent experiments I employed animals which had been inoculated with the poison of woorara, or the essential oil of almonds; by which means, while the functions of the brain were completely destroyed, the extent of the circulation was undiminished, and the chance of accidental hæmorrhage was avoided.

Exp. 5. Thermometer 65°, barometer 29·8 inch.

Two rabbits were procured, each occupying the space of 45 cubic inches. They were both inoculated with the woorara poison.

The first rabbit was apparently dead in nine minutes after the application of the poison; but the heart continued to act. The lungs were inflated for about two minutes, by means of a pair of bellows, when the thermometer in the rectum was observed to stand at 98°. The animal was then placed under the bell-glass, and artificial respiration was produced by means of pressure on the gum-bottle, as in the last experiment. At the end of 30 minutes, a portion of air was preserved for examination. The thermometer in the rectum had fallen to 91°. The heart still acted with regularity and strength.

The second rabbit died in a few minutes after the inoculation. The time was noted when the thermometer in the rectum had fallen to 98°, and he was placed under another bell-glass. At the end of 30 minutes, the thermometer in the rectum had fallen to 92°.

The air respired by the first rabbit contained $\frac{1}{20}$ of carbonic acid.

$\frac{502+52+2-45}{20}=\frac{511}{20}=25{\cdot}55$ cubic inches of carbonic acid

evolved in 30 minutes, which is at the rate of 51·1 cubic inches in an hour.

Exp. 6. Thermometer 66°, barometer 30·1 inch.

Two rabbits, each occupying the space of 48 cubic inches, were inoculated with woorara.

In one of them, when apparently dead, the circulation was kept up by means of artificial respiration. He was placed in the apparatus under the glass-bell, and the lungs were inflated from 50 to 60 times in a minute. At this time the thermometer in the rectum stood at 97°. At the end of 35 minutes, a portion of air was preserved for examination. The thermometer had now fallen to 90°. The heart was still acting regularly.

The second rabbit was allowed to lie dead. When the thermometer in the rectum had fallen to 97°, he was placed under another bell-glass. At the end of 35 minutes, the thermometer had fallen to 90·5°.

The air respired by the first rabbit contained $\frac{1}{16}$ of carbonic acid.

$\frac{502+2+52-48}{16}=\frac{508}{16}=31{\cdot}75$ cubic inches of carbonic acid evolved in 35 minutes, which is at the rate of 54·43 cubic inches in an hour.

Exp. 7. Thermometer 60°, barometer 30·2 inch.

The experiment was repeated on a rabbit which had been inoculated with the essential oil of bitter almonds. When he was placed under the bell-glass, the thermometer in the rectum stood at 96°. In a few minutes he gave signs of sensibility, and made efforts to breathe; but as these were at long intervals, and not sufficient to maintain life, the artificial respiration was continued. In half an hour he breathed spontaneously 40 times in a minute. The thermometer in the rectum had fallen to 90°.

The air being examined, was found to contain $\frac{1}{18}$ of carbonic acid.

The rabbit occupied the space of 47 cubic inches.

$\frac{502+52+2-47}{18}=\frac{509}{18}=28{\cdot}275$ cubic inches of carbonic acid

evolved in 30 minutes, which is at the rate of 56·55 cubic inches in an hour.

The animal lay as if in a state of profound sleep. At the end of two hours and 20 minutes, from the time of the poison being applied, the thermometer in the rectum had fallen to 79°, and he was again apparently dead; but the heart still continued acting, though feebly, and its action was kept up for 30 minutes longer by means of artificial breathing, when the thermometer had fallen to 76°. The carbonic acid evolved during these last 30 minutes amounted to nearly 13 cubic inches.

From the precautions with which these experiments were made, there is reason to believe that there can be no material error in their results. They appear to warrant the conclusion, that in an animal in which the brain has ceased to exercise its functions, although respiration continues to be performed, and the circulation of the blood is kept up to the natural standard; although the usual changes in the sensible qualities of the blood take place in the two capillary systems, and the same quantity of carbonic acid is formed as under ordinary circumstances, no heat is generated, and that (in consequence of the cold air thrown into the lungs) the animal cools even more rapidly than one which is actually dead.

It is a circumstance deserving of notice, that so large a quantity of air should be consumed by the blood passing through the lungs, when the functions of the brain, and those of the organs dependent on it, are suspended. Perhaps it is not unreasonable to suppose, that by pursuing this line of investigation, we may be enabled to arrive at some more precise knowledge respecting the nature of respiration, and the purposes which it answers in the animal economy. It would, however, be foreign to the plan of the present communication to enter into any speculations on this subject, and I shall therefore only remark, that the influence of the nervous system does not appear to be necessary to the production of the chemical changes which the blood undergoes in consequence of exposure to the air in the lungs.*

* This conclusion is directly contrary to that deduced by M. Dupuytren, from

The facts now, as well as those formerly adduced, go far towards proving, that the temperature of warm-blooded animals is considerably under the influence of the nervous system. But what is the nature of the connection between them? Whether is the brain directly or indirectly necessary to the production of heat? These are questions to which no answers can be given, except such as are purely hypothetical. At present we must be content with the knowledge of the insulated fact: future observations may, perhaps, enable us to refer it to some more general principle.

We have evidence, that when the brain ceases to exercise its

a series of experiments, made with a view to ascertain the effects which follow the division of the nerves of the *par vagum*, and it is an object of some importance, in the present investigation, to ascertain in what manner the apparently opposite facts, observed by M. Dupuytren and myself, are to be reconciled with each other.

It was observed by this physiologist, that in an animal, in which both the nerves of the *par vagum* are divided, the blood returned from the lungs has a darker colour than natural, and that the animals on whom this operation is performed die sooner or later with symptoms of asphyxia, notwithstanding that the air continues to enter the lungs; and hence he concludes, that the changes which are produced on the blood in respiration, are not the result of a mere chemical process, but are dependent on the nervous influence, so that they cease to take place when the communication between the lungs and the brain is destroyed.

M. Provençal, in prosecuting this inquiry, ascertained that the animals subjected to this experiment give out less carbonic acid than under ordinary circumstances.

M. Blainville observed that the frequency of the inspirations is much diminished; and M. Dumas restored the scarlet colour of the arterial blood by artificially inflating the lungs; and from these and other circumstances, he has arrived at conclusions very different from those of M. Dupuytren.

My own observations exactly correspond with those of MM. Dumas and Blainville. After the nerves of the *par vagum* are divided, a less quantity of carbonic acid is evolved, the inspirations are much diminished in frequency, and the blood in the arteries of the general system assumes a darker hue; but its natural colour may be restored by artificially inflating the lungs, so as to furnish a greater supply of air to the blood circulating through them.

We may suppose that, on the division of these nerves, the sympathy between the lungs and the nerves of inspiration is either very much impaired, or altogether destroyed, so that the animal does not experience the same impulse to draw in fresh air as under ordinary circumstances. In consequence his inspirations become less frequent than natural, and hence arise the phenomena produced by this operation.

functions, although those of the heart and lungs continue to be performed, the animal loses the power of generating heat. It would, however, be absurd to argue from this fact, that the chemical changes of the blood in the lungs are in no way necessary to the production of heat, since we know, not only that there is no instance in which it continues to take place after respiration has ceased, but that respiration is necessary to all the vital functions.

It must be owned that this part of physiology still presents an ample field for investigation.

Of opinions sanctioned by the names of Black, Laplace, Lavoisier, and Crawford, it is proper to speak with caution and respect; but without trespassing on these feelings, I may be allowed to say, that it does not appear to me that any of the theories hitherto proposed afford a very satisfactory explanation of the source of animal heat.

Where so many and such various chemical processes are going on, as in the living body, are we justified in selecting any one of these for the purpose of explaining the production of heat?

To the general theory of Dr. Black, there is this unanswerable objection, that the temperature of the lungs is not greater than that of the rest of the system. To this objection the ingenious and beautiful theory of Dr. Crawford is not open; but still it is founded on the same basis with that of Dr. Black, 'the conversion of oxygen into carbonic acid in the lungs;' and hence it appears to be difficult to reconcile either of them with the results of the experiments which have been related.

It may, perhaps, be urged, that as in these experiments the secretions had nearly, if not entirely, ceased, it is probable that the other changes which take place in the capillary vessels had ceased also; and that, although the action of the air on the blood might have been the same as under ordinary circumstances, there might not have been the same alteration in the specific heat of this fluid, as it flowed from the arteries into the veins. But on this supposition, if the theory of Dr. Crawford be admitted as

correct, there must have been a gradual but enormous accumulation of latent heat in the blood, which we cannot suppose to have taken place without its nature having been entirely altered. If the blood undergoes the usual change in the capillary system of the pulmonary, it is probable that it must undergo the usual change in the capillary system of the greater circulation also, since these changes are obviously dependent on and connected with each other. The blood in the aorta and pulmonary veins was not more florid, and that in the vena cava and pulmonary artery was not less dark-coloured, than under ordinary circumstances. We may moreover remark, that the most copious secretions in the whole body are those of the insensible perspiration from the skin, and of the watery vapour from the mouth and fauces, and the effect of these must be, not to raise, but to lower the animal temperature. Under other circumstances also, the diminution of the secretions is not observed to be attended with a diminution of heat. On the contrary, in the hot fit of a fever, when the scanty dark-coloured urine, dry skin, and parched mouth indicate that scarcely any secretions are taking place, the temperature of the body is raised above the natural standard, to which it falls when the constitution returns to its natural state, and the secretions are restored.

It has been observed, by a distinguished chemist, that 'the experiments to determine the specific heat of the blood are of so very delicate a nature, that it is difficult to receive them with perfect confidence.'* The experiments of Dr. Crawford for this purpose were necessarily made on blood out of the body, and at rest. Now, when blood is taken from the vessels, it immediately undergoes a remarkable chemical change, separating into a solid and a fluid part. This separation is not complete for some time; but whoever takes the pains to make observations on the subject can hardly doubt that it begins to take place immediately on the blood being drawn. Can experiments on the blood, under these circumstances, lead to any very satisfactory conclusions respecting

* Thomson's History of the Royal Society, p. 129.

the specific heat of blood circulating in the vessels of the body? The diluting the blood with large quantities of water, as proposed by Dr. Crawford, does not altogether remove the objection; for this only retards, it does not prevent, coagulation; and some time must, at any rate, elapse while the blood is flowing, and the quantity is being measured, during which the separation of its solid and fluid parts will have begun to take place.

More might be said on this subject; but I feel anxious to avoid, as much as possible, controversial discussion. It is my wish not to advance opinions, but simply to state some facts which I have met with in the course of my physiological investigations. These facts, I am willing to hope, possess some value; and they may perhaps lead to the development of other facts of much greater importance. Physiology is yet in its infant state. It embraces a great number and variety of phenomena, and of these it is very difficult to obtain an accurate and satisfactory knowledge; but it is not unreasonable to expect that, by the successive labours of individuals, and the faithful register of their observations, it may at last be enabled to assume the form of a more perfect science.*

* See Additional Note A, p. 69.

EXPERIMENTS AND OBSERVATIONS ON THE DIFFERENT MODES IN WHICH DEATH IS PRODUCED BY CERTAIN VEGETABLE POISONS.

From The Philosophical Transactions for 1811, Part I.

I. The following experiments were instituted with a view to ascertain in what manner certain substances act on the animal system, so as to occasion death, independently of mechanical injury. I was led to the inquiry, from the subject of it appearing to be of considerable interest and importance, and from a hope, that, in the present improved state of physiological knowledge, we might be enabled to arrive at some more satisfactory conclusions than had been deduced from any further observations.

The substances which act as poisons when applied to the animal body are very numerous. In the experiments which I have hitherto made, I have employed vegetable poisons only. Of these I have selected such as are very active and certain in producing their effects, believing that, on this account, the exact nature of those effects would be more readily ascertained. The principal objects which I have kept in view have been to determine on which of the vital organs the poison employed exercises its primary influence, and through what medium that organ becomes affected. I have also endeavoured to ascertain by what means the fatal consequences of some poisons may be prevented. With some of the conclusions which I have ventured to draw, as far as I know, we were not before acquainted; and others of them, though not entirely new, had not been previously established by satisfactory experiments.

I shall relate first those experiments in which poisons were

applied internally, that is, to the mucous membranes of the tongue or alimentary canal, and afterwards those in which poisons were applied to wounded surfaces.

II. *Experiments with Poisons applied to the Tongue, or Alimentary Canal.*

EXPERIMENTS WITH ALCOHOL.

When spirits are taken into the stomach, in a certain quantity, they produce, not at once, but gradually, that kind of delirium which constitutes intoxication: when taken in a larger quantity, it is well known that they destroy life altogether, and that in the course of a very short space of time. Intoxication is a derangement of the functions of the mind, and as these are in some way connected with those of the brain, it seems probable that it is by acting on this organ that spirits, when taken into the stomach, occasion death. In order to ascertain how far this conclusion is just, I made the following experiments.*

Exp. 1. I poured two drachms of proof spirits down the œsophagus of a cat. Instantly he struggled violently; then lay on one side, perfectly motionless and insensible; the breathing was laboured and stertorous, and the pulsations of the heart were very frequent. He continued in this state for seven or eight minutes; then began to recover; the respirations became easier, and presently he stood up, and was able to walk.

Exp. 2. I injected an ounce and a half of proof spirits into the stomach of a large full-grown rabbit, by means of an elastic gum tube passed down the œsophagus. The same symptoms took place as in the last experiment; but the animal did not begin to recover from the state of insensibility until 40 minutes had elapsed from the time of the injection.

* I am indebted to Dr. E. N. Bancroft for his assistance in many of the experiments which I am about to detail. Mr. W. Brande lent me his assistance in the greater part of those which were made. I have been further assisted on these, as well as on former occasions, by Mr. Broughton, and by some of my own pupils.

Exp. 3. Seven drachms of proof spirits were injected into the stomach of a younger rabbit. Two minutes afterwards he evidently was affected by the spirits, and in three minutes more he lay on one side motionless and insensible. The pupils of the eyes were perfectly dilated; there were occasional slight convulsive motions of the extremities; the respiration was laborious, it was gradually performed at longer and longer intervals, and at the end of an hour and fifteen minutes had entirely ceased. Two minutes after the animal was apparently dead, I opened into the thorax, and found the heart acting with moderate force and frequency, circulating dark-coloured blood. I introduced a tube into the trachea, and produced artificial respiration by inflating the lungs, and found that by these means the action of the heart might be kept up to the natural standard, as in an animal from whom the head is removed.

Exp. 4. I injected into the stomach of a rabbit two ounces of proof spirits. The injection was scarcely completed when the animal became perfectly insensible. Precisely the same symptoms took place as in the last experiment, and at the end of 27 minutes from the time of the injection the rabbit was apparently dead; but on examining the thorax the heart was found still acting, as in the last experiment.

It has been shown by M. Bichat, and the observation has been confirmed by some experiments which I have lately had the honour of communicating to this learned Society, that the brain is not directly necessary to the action of the heart, and that, when the functions of the brain are destroyed, the heart continues to contract for some time afterwards, and then ceases only in consequence of the suspension of respiration, which is under the influence of the brain.

It would appear, from the experiments which I have just detailed, that the symptoms produced by a large quantity of spirits taken into the stomach arise entirely from disturbance of the functions of the brain. The complete insensibility to external impressions, the dilatation of the pupils of the eyes, and the loss of motion,

indicate that the functions of this organ are suspended; respiration, which is under its influence, is ill performed, and at last altogether ceases; while the heart, to the action of which the brain is not directly necessary, continues to contract, circulating dark-coloured blood for some time afterwards.

There is a striking analogy between the symptoms arising from spirits taken internally, and those produced by injuries of the brain.

Concussion of the brain, which may be considered as the slightest degree of injury, occasions a state of mind resembling intoxication, and the resemblance in some instances is so complete, that the most accurate observer cannot form a diagnosis, except from the history of the case. Pressure on the brain, which is a more severe injury than concussion, produces loss of motion, insensibility, dilatation of the pupils; the respiration becomes laboured and stertorous, is performed at long intervals, at last altogether ceases, and the patient dies.

It forms an interesting matter of inquiry, whether spirits when taken into the stomach produce their effects on the brain by being absorbed into the circulation, or in consequence of the sympathy that exists between these organs by means of the nerves. The following circumstances lead me to conclude that, when taken in large quantity so as to produce an immediate effect, they act in the last of these two ways.

1. In experiments where animals have been killed by the injection of spirits into the stomach, I have found this organ to bear the marks of great inflammation, but never found any preternatural appearances whatever in the bain. 2. The effects of spirits taken into the stomach in the last experiment were so instantaneous, that it is difficult to suppose that absorption should have taken place before they were produced. 3. A person who is intoxicated frequently becomes suddenly sober after vomiting. 4. In the experiments which I have just related, I mixed tincture of rhubarb with the spirits, knowing from the experiments of Mr. Home and Mr. William Brande that this, when absorbed into the circulation,

was readily separated by the kidneys, and that very small quantities might be detected in the urine by the addition of potash; but, though I never failed to find urine in the bladder, I never detected rhubarb in it.

The including the termination of the thoracic duct in a ligature does not prevent spirits, when taken into the stomach, from producing their usual effects on the nervous system: but subsequent observations, which Mr. Home has already communicated to this Society, have shown that no conclusion can be drawn from this experiment.

That a poison may affect a distant organ, through the medium of the nerves, without entering the circulation, is proved by the well-known circumstance of a solution of the extract of *belladonna*, when applied to the tunica conjunctiva of the eye, occasioning dilatation of the pupil of the same eye, though no other part of the system is affected.

It has been formerly supposed, by Dr. Mead and other physiologists, that a poison may produce death by acting on the extremities of the nerves of the stomach and intestines, without being absorbed into the circulation. That it should by these means be capable of affecting the brain is in no degree remarkable, considering the numerous and various sympathies between this organ and the alimentary canal, evidently independent of any other communication than the nerves.*

EXPERIMENTS WITH THE ESSENTIAL OIL OF BITTER ALMONDS.†

Exp. 5. One drop of the essential oil of bitter almonds was applied to the tongue of a young cat. She was instantly seized with violent convulsions; then lay on one side motionless, insensible, breathing in a hurried manner; the respiration became laborious, took place at longer and longer intervals, and at the end of five minutes from the application of the poison had entirely ceased, so that

* See Additional Note B, p. 80.

† The essential oil of bitter almonds does not appear to differ from the essential oil of laurel. I was furnished with a quantity of it, first by my friend Mr. William Brande, and afterwards by Mr. Cooke, of Southampton Street.

the animal was apparently dead; but, on opening the thorax, the heart was found acting regularly 80 times in a minute, circulating dark-coloured blood, and it continued to act for six or seven minutes afterwards.

Exp. 6. I injected into the rectum of a cat half an ounce of water, with two drops of the essential oil. In two minutes afterwards, he was affected with symptoms similar to those which occurred in the last experiment, and at the end of five minutes from the injection of the poison he was apparently dead. Two minutes afterwards the heart was found acting 80 times in a minute. On dissection, no preternatural appearances were found, either in the internal membrane of the rectum or in the brain.

The symptoms produced by this poison, and the circumstance of the heart continuing to contract after apparent death, lead to the conclusion that it occasions death by disturbing the functions of the brain.

While engaged in these last experiments, I dipped the blunt end of a probe into the essential oil, and applied it to my tongue, meaning to taste it, and having no suspicion that so small a quantity could produce any of its specific effects on the nervous system; but scarcely had I applied it, when I experienced a very remarkable and unpleasant sensation, which I referred chiefly to the epigastric region, but the exact nature of which I cannot describe, because I know nothing precisely similar to it. At the same time there was a sense of weakness in my limbs, as if I had not the command of my muscles, and I thought that I was about to fall. However, these sensations were momentary, and I experienced no inconvenience whatever afterwards.

I afterwards applied a more minute quantity of the essential oil to my tongue several times, without experiencing from it any disagreeable effects; but on applying a larger quantity, I was affected with the same momentary sensations as in the former instance, and there was a recurrence of them in three or four seconds after the first attack had subsided.*

* See Additional Note C, p. 83.

From the instantaneousness with which the effects are produced; and from its acting more speedily when applied to the tongue than when injected into the intestine, though the latter presents a better absorbing surface, we may conclude that this poison acts on the brain through the medium of the nerves, without being absorbed into the circulation.

EXPERIMENT WITH THE EXPRESSED JUICE OF THE LEAVES OF ACONITE.

Exp. 7. An ounce of this juice was injected into the rectum of a cat. Three minutes afterwards he voided what appeared to be nearly the whole of the injection; he then stood for some minutes perfectly motionless, with his legs drawn together. At the end of nine minutes from the time of the injection, he retched and vomited; then attempted to walk, but faltered and fell at every step, as if from giddiness. At the end of thirteen minutes, he lay on one side insensible, motionless, except some slight convulsive motions of the limbs. The respiration was slow and laboured; and at 47 minutes from the time of the injection, he was apparently dead. One minute and a half afterwards the heart was found contracting regularly one hundred times in a minute.

It appears from this experiment, that the juice of aconite, when injected into the intestine, occasions death by destroying the functions of the brain. From the analogy of other poisons, it is rendered probable that it is capable of influencing the brain through the medium of the nerves, without being absorbed into the circulation. This opinion is confirmed by the following circumstance: if a small quantity of the leaf of aconite is chewed, it occasions a remarkable sense of numbness of the lips and gums, which does not subside for two or three hours.

EXPERIMENTS WITH THE INFUSION OF TOBACCO.

Exp. 8. Four ounces of infusion of tobacco were injected into the rectum of a dog. Four minutes afterwards he retched, but did not vomit; he then became faint, and lay motionless on one side; at the end of nine minutes from the time of the injection, the heart

could not be felt; he gasped for breath at long intervals; and in another minute there was no appearance whatever of life. I immediately laid open the cavities of the thorax and abdomen. The heart was much distended, and had entirely ceased to contract; there was no peristaltic motion of the intestines.

Exp. 9. An ounce of very strong infusion of tobacco was injected into the rectum of a cat. Symptoms were produced similar to those which occurred in the last experiment, and the animal died at the end of seven minutes from the time of the injection. On opening the thorax immediately after death, the heart was found extremely distended, and to have entirely ceased acting, with the exception of a slight tremulous motion of the auricles.

Exp. 10. Three ounces of infusion of tobacco were injected into the rectum of a dog. He was affected with symptoms similar to those in the former experiments, and died at the end of ten minutes. On opening the thorax immediately after death, I found the heart much distended, and to have entirely ceased contracting.

Exp. 11. Three ounces of infusion of tobacco were injected into the rectum of a dog. Immediately there took place tremulous contractions of the voluntary muscles. Five minutes afterwards the injection was repeated in the same quantity. The dog then was sick, and threw up some of the infusion, with other matter, from the stomach; he became faint, and died ten minutes after the second injection. Immediately after respiration had ceased, I opened the thorax, and found the heart extremely distended, and without any evident contraction, except of the appendix of the right auricle, which every now and then contracted in a slight degree. I divided the pericardium on the right side. In consequence of the extreme distension of the heart, this could not be done without irritating the fibres with the point of the scalpel. Immediately both auricles and ventricles began to contract with considerable force, so as to restore the circulation. Artificial respiration was produced, and the circulation was kept up for more than half an hour, beyond which time the experiment was not continued.

We may conclude from these experiments, that the effect of the

infusion of tobacco, when injected into the intestine of a living animal, is to destroy the action of the heart, stopping the circulation and producing syncope.* It appeared to me that the action of the heart ceased even before the animal had ceased to respire; and this was confirmed by another experiment, in which, in a dog killed by the infusion of tobacco, I found the cavities of the left side of the heart to contain scarlet blood, while in those of the right side the blood was dark-coloured. This poison, therefore, differs materially from alcohol, the essential oil of almonds, and the juice of aconite, which have no direct influence on the action of the heart. The infusion of tobacco renders the heart insensible to the accustomed stimulus, but it does not altogether destroy the power of muscular contraction, since the heart resumed its action in one instance on the division of the pericardium; and I have found that the voluntary muscles of an animal killed by this poison are as readily stimulated to contract by the influence of the Voltaic battery, as if it had been killed in any other manner. At the same time, however, that the infusion of tobacco destroys the action of the heart, it appears to destroy also the functions of the brain, since these did not return in the last experiment; although the circulation was restored, and kept up by artificial respiration.

There being no direct communication between the intestine and the heart, I was at first induced to suppose that the latter becomes affected only in consequence of the infusion being conveyed into the blood. Some circumstances in the following experiment have since led me to doubt whether it may not exercise an influence over the system independently of absorption.

Exp. 12. In a dog whose head was removed, I kept up the circulation by means of artificial respiration, in the manner already described in a former communication to this Society. I then injected into the stomach and intestines nine ounces of infusion of tobacco. At the time of the injection, the body of the animal lay perfectly quiet and motionless on the table; the heart acted regularly 100

* See Additional Note D, p. 84.

times in a minute. Ten minutes afterwards the pulse rose to 140 in a minute; the peristaltic motion of the intestines was much increased, and the voluntary muscles in every part of the body were thrown into repeated and violent spasmodic action. The joints of the extremities were alternately bent and extended; the muscles of the spine, abdomen, and tail alternately relaxed and contracted, so as to turn the whole animal from one side to the other. I have observed, in other instances, spasmodic actions of the muscles, where the circulation was kept up by artificial respiration, after the removal of the head, but not at all to be compared, either in strength or frequency, with those which took place on this occasion. I made pressure on the abdominal aorta for more than a minute, so as to obstruct the circulation of the blood in the lower extremities; but the muscular contractions were not lessened in consequence. Half an hour after the injection of the infusion, the artificial respiration was discontinued. The heart continued to act, circulating dark-coloured blood; and the muscular contractions continued, but gradually diminishing in strength and frequency. I tied a ligature round the vessels at the base of the heart, so as to stop the circulation; nevertheless the muscular contractions continued, though less frequent and forcible than before, and some minutes elapsed before they had entirely ceased.

In this experiment, the disposition to contraction in the muscles was very much increased, instead of being diminished, as in those before related. If the infusion of tobacco influences the heart merely from being absorbed into the blood, and thus coming into actual contact with its fibres, there is no evident reason why the removal of the brain, and the employment of artificial respiration, should occasion so material a difference in its effects. If the contractions of the voluntary muscles had depended on the infusion circulating with the blood, it is reasonable to suppose that the pressure on the aorta would have occasioned some diminution of them, and that the complete obstruction of the circulation would have caused them to cease altogether.

From these considerations, I am induced to believe that the

infusion of tobacco, when injected into the intestines, influences the heart through the medium of the nervous system; but I have not been able to devise any experiment by which the truth or fallacy of this opinion might be put beyond the reach of doubt.

It appears remarkable, that the brain and nervous system, although not necessary to the action of the heart, should, when under the influence of the infusion of tobacco, be capable of acting on this organ so as to stop its action; but this is analogous to what occurs in consequence of violent emotions of the mind. Those states of the nervous system which accompany the passions of joy, fear, or anger, when existing in a moderate degree, have the effect of increasing the frequency of the contractions of the heart, and the rapidity of the circulation, while the same passions, if they exist in a greater degree, produce the contrary effect, so that syncope ensues.

EXPERIMENTS WITH THE EMPYREUMATIC OIL OF TOBACCO.*

Exp. 13. Less than a drop of this oil was applied to the tongue of a young cat. Instantly violent convulsions took place in all the muscles, and the respirations became very frequent. In five minutes after the application, she lay on one side insensible, with slight spasmodic actions of the muscles. At the end of eleven minutes she retched, but did not vomit. In a quarter of an hour she appeared to be recovering. I repeated the application of the poison, and she was again seized with violent convulsions, and became insensible, breathing at long intervals, and in two minutes from the second application respiration had entirely ceased, and she was apparently dead. On opening the thorax, I found the heart acting with regularity and strength, circulating dark-coloured blood. I introduced a tube into the trachea, and produced artificial respiration. The contractions of the heart became augmented in force

* I was furnished with the empyreumatic oil of tobacco by Mr. W. Brande. It may be produced by subjecting the leaves of tobacco to distillation in a heat above that of boiling water. A watery fluid comes over, on the surface of which is the oil appearing as a thin film of unctuous substance.

and frequency, and there was no evident diminution in six or seven minutes, during which the artificial respiration was continued.

On dissection, nothing remarkable was found in the appearance of the tongue or brain.

The symptoms and mode of death in this experiment did not essentially differ from those produced by the essential oil of almonds. I was surprised to find the effects of the empyreumatic oil so entirely different from those of the infusion of tobacco. Supposing that this difference might arise from the poison being more concentrated in the oil than in the infusion, I made the following experiments.

Exp. 14. A drop of the oil of tobacco was suspended in an ounce and a half of water, by means of mucilage of gum arabic, and the whole was injected into the rectum of a dog. In two minutes afterwards he became faint, retched, but did not vomit. He appeared to be recovering from this state, and in twenty-five minutes after the first injection it was repeated in the same quantity. He was then seized with symptoms similar to those in the last experiment, and in two minutes and a half he was apparently dead.

Two minutes after apparent death, on the thorax being opened into, the heart was found acting regularly 100 times in a minute, and it continued acting for several minutes.

Exp. 15. A drop of the empyreumatic oil of tobacco with an ounce of water was injected into the rectum of a cat. The symptoms produced were, in essential circumstances, similar to those which occurred in the last experiment. The animal was apparently dead in five minutes after the injection, and the heart continued to contract for several minutes afterwards.

We may conclude from these experiments, that the empyreumatic oil of tobacco, whether applied to the tongue, or injected into the intestine, does not stop the action of the heart and induce syncope, like the infusion of tobacco; but that it occasions death by destroying the functions of the brain without directly acting on the circulation. In other words, its effects are similar to those of alcohol, the juice of aconite, and the essential oil of almonds.

III. *Experiments with Poisons applied to Wounded Surfaces.*

EXPERIMENTS WITH THE ESSENTIAL OIL OF ALMONDS.

Exp. 16. I made an incision in the thigh of a rabbit, and introduced two drops of the essential oil of almonds between the skin and the muscles. In four minutes after the application, he was seized with violent convulsions, and became insensible, and in two minutes more he was apparently dead; but the heart was felt through the ribs acting 120 times in a minute, and it continued acting for several minutes. There were no other appearances in the limb, than would have resulted from an ordinary wound.

Exp. 17. Two drops of the essential oil of almonds were introduced into a wound in the side of a mouse. Two minutes afterwards he was affected with symptoms similar to those which occurred in the last experiment, and in two minutes more he was apparently dead, but the heart continued to contract for some minutes afterwards.

From the experiments which I have just related, and from others which it appears unnecessary to detail, as the general results were the same, I have learned that where the essential oil of almonds is applied to a wound, its effects are *not so instantaneous* as when it is applied to the tongue; but that otherwise there is no difference in its effects in whichever manner it is used.

EXPERIMENTS WITH THE JUICE OF THE LEAVES OF THE ACONITE.

Exp. 18. I made a wound in the side of a young rabbit, and introduced, between the skin and muscles, about twenty drops of the juice of aconite. 23 minutes afterwards he was affected with symptoms, in all essential respects, similar to those which occurred in an experiment already related, where the juice was injected into the rectum, and at the end of 47 minutes from the application of the poison, he was apparently dead. Two minutes after apparent death, the heart was found contracting, but very feebly.

EXPERIMENTS WITH THE WOORARA.*

Exp. 19. A small quantity of the woorara in powder was applied to a wound in the side of a guinea pig. In 10 minutes afterwards the animal was unable to walk; then he became quite motionless, except some slight occasional convulsions. He gradually became insensible, the respirations were laboured, and at the end of 14 minutes from the application of the poison, the respiration had entirely ceased, and he was apparently dead; but on opening the thorax, the heart was found acting 70 times in a minute, circulating dark-coloured blood, and it continued to contract for several minutes afterwards. On dissection, no preternatural appearances were observed in the brain; nor was there any other appearance in the limb than would have arisen from an ordinary wound.

Exp. 20. I made a wound in the side of a guinea-pig, and introduced into it about two grains of the woorara in powder. At the end of 25 minutes, symptoms took place very similar to those which occurred in the last experiment, and in 13 minutes more the animal was apparently dead; but the heart continued to contract 108 times in a minute, and by means of artificial respiration the circulation was kept up for more than 20 minutes.

The results of other experiments which I have made with the woorara were similar to those just described. The heart continued to act after apparent death, and the circulation might be kept up by means of artificial respiration. It is evident that this poison acts in some way or other on the brain, and that the cessation of the functions of this organ is the immediate cause of death.

I found in these experiments, that the best mode of applying the woorara is by dissolving it in water to the consistence of a thin paste. I first made the wound, and then smeared the poison

* The Woorara is a poison with which the Indians of Guiana arm the points of their arrows. It appears not to differ essentially from the Ticunas, which was employed in the experiments of the Abbé Fontana. I am indebted to Dr. E. N. Bancroft, who not only furnished me with some of the Woorara which he had in his possession, but also lent me his assistance in the experiments which were made with it.

over it with the end of the scalpel. It seemed that the animal was more speedily and certainly affected, if there was some hæmorrhage, unless the hæmorrhage was very copious, when it produced an opposite effect, by washing the poison away from the wound. When the poison was applied in a large quantity, it sometimes began to act in six or seven minutes. Never more than half an hour elapsed from the time of the poison being inserted, to that of the animal being affected, except in one instance where a ligature was applied on the limb, as will be explained afterwards. The woorara which I employed had been preserved for some years, which will account for its having been less active than it has been described to be, by those who had witnessed its effects when in a recent state.*

EXPERIMENTS WITH THE UPAS ANTIAR.†

Exp. 21. About two grains of this poison were made into a thin paste with water, and inserted into a wound in the thigh of a dog. Twelve minutes afterwards he became languid; at the end of 15 minutes, the heart was found to beat very irregularly, and with frequent intermissions; after which, he had a slight rigor. At the end of 20 minutes the heart beat very feebly and irregularly; the dog was languid, sick, and vomited; but the respirations were as frequent and as full as under natural circumstances, and he was perfectly sensible. At the end of 20 minutes he suddenly fell on one side, and was apparently dead. I immediately opened the thorax, and found the heart distended with blood in a very remarkable degree, and to have entirely ceased contracting. There was one distinct and full inspiration after I had begun making the incision into the thorax. The cavities of the left side of the heart contained scarlet blood, and those of the right side contained dark-coloured blood, as in a living animal.

* See Additional Note E, p. 84.

† We are informed that the island of Java produces two powerful vegetable poisons, to one of which the natives give the name of *Upas tieutè*, and to the other that of *Upas antiar*. I was supplied with a quantity of the latter through the kindness of Mr. Marsden, who had some of it in his possession.

Exp. 22. A small quantity of the upas antiar, prepared as before, was inserted into a wound in the thigh of a young cat. She appeared languid in two minutes after the poison was inserted. The symptoms which took place did not essentially differ from those which occurred in the last experiment, except that there were some convulsive motions of the limbs. At eight minutes after the poison was inserted she lay on one side, motionless and insensible; the heart could not be felt, but the respiration had not entirely ceased. On opening the thorax, I found the heart to have ceased contracting. It was much distended with blood: and the blood in the cavities of the left side was of a scarlet colour. There were two full inspirations after the incision of the thorax was begun. On irritating the heart with the point of the scalpel, slight contractions took place in the fibres of the appendices of the auricles, but none in any other part.

Exp. 23. The experiment was repeated on a rabbit. The symptoms produced were similar to those in the last experiment; but the animal did not vomit, and the convulsive motions were less in degree. He died 11 minutes after the poison was inserted. On opening the thorax, the heart was found to have entirely ceased contracting. It was much distended with blood; and the blood in the cavities of the left side was of a scarlet colour. On irritating the heart with the point of the scalpel, the ventricles contracted, but not sufficiently to restore the circulation.

Exp. 24. About a grain of the upas antiar was inserted into a wound in the side of a rabbit. He was affected with symptoms similar to those before described, and died in 10 minutes after the poison was applied. On opening the thorax immediately after death, the heart was found to have ceased contracting, and the blood in the cavities of the left side was of a scarlet colour.

It appears, from these experiments, that the upas antiar, when inserted into a wound, produces death (as infusion of tobacco does when injected into the intestine) by rendering the heart insensible to the stimulus on which its action depends, and stopping the circulation. The heart beats feebly and irregularly before either

the functions of the brain, or the respiration appear to be affected. Respiration is performed even after the circulation has ceased; and the left side of the heart is found after death to contain scarlet blood, which never can be the case where the cause of death is the cessation of the functions of the brain or lungs. The convulsions which occur when the circulation has nearly ceased, probably arise from the diminution of the supply of blood to the brain, resembling those which accompany death from hæmorrhage.

There remains an interesting subject of inquiry, 'through what medium do poisons influence the brain when applied to wounds?' That poisons applied in this manner do not produce their effects precisely in the same way as poisons taken internally, is rendered probable by this circumstance; that some poisons, which are very powerful when applied to wounds even in small quantities, are either altogether inefficient when taken internally, or require to be given in very large quantities, in order to produce their effect, and vice versâ.

A poison applied to a wounded surface may be supposed to act on the brain in one of three ways:

1. By means of the nerves, like poisons taken internally.

2. By passing into the circulation through the lymphatic vessels.

3. By passing directly into the circulation through the divided veins.

Exp. 25. In order to ascertain whether the woorara acts through the medium of the nerves, I exposed the axilla of a rabbit, and divided the spinal nerves supplying the upper extremity, just before they unite to form the axillary plexus. I not only divided every nervous filament, however small, which I could detect, but every portion of cellular membrane in the axilla, so that the artery and vein were left entirely insulated. I then made two wounds in the forearm, and inserted into them some of the woorara formed into a paste. Fourteen minutes after the poison was applied, the hind legs became paralytic, and in 10 minutes more the animal died, with symptoms precisely similar to those which took place in the

former experiments with the same poison, the heart continuing to act after apparent death. On dissection, the nerves of the upper extremity were very carefully examined, but not the smallest filament could be found undivided.

I made the following experiment to ascertain whether the woorara passes into the circulation through the lymphatic vessels.

Exp. 26. I tied a ligature round the thoracic duct of a dog, just before it perforates the angle of the left subclavian and jugular veins. I then made two wounds in the left hind leg, and introduced some of the woorara in powder into them. In less than a quarter of an hour the animal became affected with the usual symptoms, and died in a few minutes afterwards.

After death, I dissected the thoracic duct with great care, and found it to have been perfectly secured by the ligature. It was very much distended with chyle, and about two inches below its termination its tunics had given way, and chyle was extravasated into the cellular membrane. The lymphatic vessels in the left axilla were distended in a very remarkable degree, and on dividing them, not less than a drachm of lymph issued from the divided ends.

Since neither the division of the nerves nor the obstruction of the thoracic duct interfere in the slightest degree with the effects of the woorara, there was presumptive evidence that it acts on the brain by entering the circulation through the divided veins. I next endeavoured to ascertain, by a more direct experiment, whether this is really the case.

To apply ligatures to the large vessels of a limb only, would evidently lead to no satisfactory conclusion, since the anastomosing vessels might still carry on the circulation. The only method, which I could devise, of obtaining the desired information, was to include all the vessels, small as well as large, in a ligature.

Exp. 27. In order to make the experiment more satisfactorily, I exposed the sciatic nerve of a rabbit in the upper and posterior part of the thigh, and passed under it a tape half an inch wide. I then made a wound in the leg, and having introduced into it some of the

woorara mixed with water, I tied the tape moderately tight on the fore part of the thigh. Thus I interrupted the communication between the wound and the other parts of the body, by means of the vessels, while that by means of the nerve still remained. After the ligature was tightened, I applied the woorara a second time, in another part of the leg. The rabbit was not at all affected, and at the end of an hour I removed the ligature. Being engaged in some other pursuit, I did not watch the animal so closely as I should otherwise have done; but 20 minutes after the ligature had been removed, I found him lying on one side, motionless and insensible, evidently under the influence of the poison. The symptoms, however, were less violent than in most instances; and after some time he recovered, with the limb perfectly warm and using it as well as before.

Exp. 28. I repeated the last experiment with this difference, that after having applied the poison, I made the ligature as tight as I could draw it. I removed the ligature at the end of an hour and twenty minutes, but the animal was not at all affected either before or after the removal of the ligature, and on the following day he had recovered the use of the limb.

Exp. 29. I made the experiment a third time on a rabbit, drawing the ligature very tight. At the end of 45 minutes he continued perfectly well, and the ligature was removed. I watched him for three-quarters of an hour afterwards, but there were no symptoms of his being affected by the poison. On the following day he died, but this I attribute to the mechanical injury done to the limb and sciatic nerve, as there was the appearance of inflammation in the parts in the neighbourhood of the ligature.

These three experiments were made with the greatest care. From the mode in which the poison was applied, from the quantity employed, and from my prior experience, I should have entertained not the smallest doubt of the poison taking effect in every instance in less than 20 minutes, if no ligature had been applied. In two of the three, the quantity of woorara was more than had been used in any former experiments.

I have not judged it necessary to make any more experiments with the ligature on the limb, because the numerous experiments of the Abbé Fontana on the ticunas coincide in their results with those which have just been detailed, and fully establish the efficacy of the ligature, in preventing the action of the poison. It is not to be wondered at, that the ligature should sometimes fail in its effects, since these must evidently depend on the degree in which the circulation is obstructed, and on the length of time during which the obstruction is continued.

There can then be little doubt that the woorara affects the brain, by passing into the circulation through the divided vessels.* It is probable, that it does not produce its effects until it enters the substance of the brain, along with the blood, in which it is dissolved; nor will the experiments of the Abbé Fontana, in which he found the ticunas produce almost instant death when injected into the jugular vein of a rabbit, be found to militate against the conclusion, when we consider how short is the distance which, in so small an animal, the blood has to pass from the jugular vein to the carotid artery, and the great rapidity of the circulation; especially in a rabbit under the influence of powerful excitement, in whom the heart cannot be supposed to act so seldom as three times in a second.

I have made no experiments to ascertain through what medium other poisons operate when applied to wounds; but from analogy, we may suppose, that they also enter the circulation through the divided blood-vessels.

IV. The facts already related, led me to conclude that alcohol, the essential oil of almonds, the juice of aconite, the oil of tobacco, and the woorara, occasion death simply by destroying the functions of the brain. The following experiment appears fully to establish the truth of this conclusion.

Exp. 30. The temperature of the room being 58° Fahrenheit's thermometer, I made two wounds in the side of a rabbit, and applied

* See Additional Note F, p. 86.

to them some of the woorara in the form of paste. In seven minutes after the application, the hind legs were paralysed, and in 15 minutes respiration had ceased, and he was apparently dead. Two minutes afterwards the heart was still beating, and a tube was introduced through an opening into the trachea, by means of which the lungs were inflated. The artificial respiration was made regularly about 36 times in a minute.

At first, the heart contracted 100 times in a minute.

At the end of 40 minutes, the pulse had risen to 120 in a minute.

At the end of an hour, it had risen to 140 in a minute.

At the end of an hour and 23 minutes, the pulse had fallen to 100, and the artificial respiration was discontinued.

At the commencement of the experiment, the ball of a thermometer being placed in the rectum, the quicksilver rose to 100°; at the close of the experiment it had fallen to 88½°.

During the continuance of the artificial respiration, the blood in the femoral artery was of a florid red, and that in the femoral vein was of a dark colour, as usual.

It has been observed by M. Bichat, that the immediate cause of death, when it takes place suddenly, must be the cessation of the functions of the heart, the brain, or the lungs. This observation may be extended to death under all circumstances. The stomach, the liver, the kidneys, and many other organs are necessary to life, but their *constant* action is not necessary; and the cessation of their functions cannot therefore be the *immediate* cause of death. As in this case the action of the heart had never ceased; as the circulation of the blood was kept up by artificial respiration for more than an hour and 20 minutes after the poison had produced its full effects; and as during this time the usual changes in the colour of the blood took place in the lungs; it is evident that the functions of the heart and lungs were unimpaired: but that those of the brain had ceased, is proved by the animal having continued in a state of complete insensibility, and by this circumstance, that animal heat, to the generation of which I have formerly shown the influence of the brain to be necessary, was not generated.

Having learned that the circulation might be kept up by artificial respiration for a considerable time after the woorara had produced its full effects, it occurred to me, that in an animal under the influence of this or of any other poison that acts in a similar manner, by continuing the artificial respiration for a sufficient length of time after natural respiration had ceased, the brain might recover from the impression which the poison had produced, so that it would be restored to life. In the last experiment the rabbit gave no signs of returning sensibility; but it is to be observed, 1. That the quantity of poison employed was very large. 2. That there was a great loss of animal heat, in consequence of the temperature of the room being much below the natural temperature of the animal, which could not therefore be considered under such favourable circumstances as to recovery as if it had been kept in a higher temperature. 3. That the circulation was still vigorous when I left off inflating the lungs, and therefore it cannot be known what would have been the result, if the artificial respiration had been longer continued.

Exp. 31. A wound was made in the side of a rabbit. One drop of the essential oil of almonds was inserted into it; and immediately the animal was placed in a temperature of 90°. In two minutes he was under the influence of the poison. The usual symptoms took place. In three minutes more, respiration had ceased, and he lay apparently dead, but the heart was still felt beating through the ribs. A tube was then introduced into one of the nostrils, and the lungs were inflated about 35 times in a minute. Six minutes after the commencement of artificial respiration, he moved his head and legs, and made an effort to breathe. He then was seized with convulsions, and again lay motionless, but continued to make occasional efforts to breathe. Sixteen minutes after its commencement the artificial respiration was discontinued. He now breathed spontaneously 70 times in a minute, and moved his head and extremities. After this he occasionally rose, and attempted to walk. In the intervals he continued in a dozing state, but from this he gradually recovered.

In less than two hours he appeared perfectly well, and he continued well on the following day.

The inflating the lungs has been frequently recommended in cases of suffocation, where the cause of death is the cessation of the functions of the lungs. As far as I know, it has not been before proposed in those cases in which the cause of death is the cessation of the functions of the brain.* It is probable that this method of treatment might be employed with advantage for the recovery of persons labouring under the effects of opium, and many other poisons.

V. The experiments which have been detailed lead to the following conclusions:—

1. Alcohol, the essential oil of almonds, the juice of aconite, the empyreumatic oil of tobacco, and the woorara, act as poisons by simply destroying the functions of the brain; universal death taking place, because respiration is under the influence of the brain, and ceases when its functions are suspended.

2. The infusion of tobacco when injected into the intestine, and the upas antiar when applied to a wound, have the power of rendering the heart insensible to the stimulus of the blood, thus stopping the circulation; in other words, they occasion death by syncope.

3. There is reason to believe, that the poisons, which in these experiments were applied internally, produce their effects through the medium of the nerves, independently of their being absorbed into the circulation.

4. When the woorara is applied to a wound, it produces its effects on the brain, by entering the circulation through the divided

* Since this paper was read, I have been favoured by the Right Hon. the President with the perusal of a Dissertation on the Effects of the Upas Tieutè, lately published at Paris by M. Delile, by which I find that he had employed artificial respiration for the purpose of recovering animals which were under the influence of this poison, with success. M. Delile describes the Upas Tieutè as causing death by occasioning repeated and long-continued contractions of the muscles of respiration, on which it acts through the medium of the spinal chord, without destroying the functions of the brain.

blood-vessels; and from analogy it appears probable that other poisons, when applied to wounds, operate in a similar manner.

5. When an animal is apparently dead from the influence of a poison which acts merely by destroying the functions of the brain, it may, in some instances at least, be made to recover, if respiration is artificially produced and continued for a certain length of time.

From analogy we might draw some conclusions respecting the mode in which some other vegetable poisons produce their effects on the animal system; but I forbear to enter into any speculative inquiries, as it is my wish, in the present communication, to record such facts only as appear to be established by actual experiment.

FURTHER OBSERVATIONS AND EXPERIMENTS ON THE ACTION OF POISONS ON THE ANIMAL SYSTEM.

From The Philosophical Transactions for 1812.

SINCE I had the honour of communicating to the Royal Society some Observations on the Action of certain Poisons on the Animal System, I have been engaged in the further prosecution of this inquiry. Besides some additional experiments on vegetable poisons, I have instituted several with a view to explain the effects of some of the more powerful poisons of the mineral kingdom. The former correspond in their results so nearly with those which are already before the public, that in the present communication I shall confine myself to those which appear to be of some importance, as they confirm my former conclusions respecting the recovery of animals apparently dead, where the cause of death operates exclusively on the nervous system. In my experiments on mineral poisons, I have found some circumstances wherein their effects differ from those of vegetable poisons; and of these I shall give a more particular account. Whatever may be the value of the observations themselves, the subject must be allowed to be one that is deserving of investigation, as it does not appear unreasonable to expect that such physiological investigations may hereafter lead to some practical improvements in the healing art. This consideration, I hope, will be regarded as a sufficient apology for my pursuing a mode of inquiry, by means of experiments on brute animals, of which we might question the propriety, if no other purpose were to be answered by it than the gratification of curiosity.

In my former communication on this subject I entered into a detailed account of the majority of the experiments which were made. This I conceived necessary, because, in the outset of the inquiry, I had been led to expect that even the same poison may not always operate precisely in the same manner. But I have since had abundant proof that, in essential circumstances, there is but little variety in the effects produced by any one poison, when employed on animals of the same, or even of different species, beyond what may be referred to difference in quantity, or the mode of its application, or of the age and power of the animal. This will explain the reason of my not detailing, in the present communication, so many of the individual experiments from which my conclusions are drawn, as in the former. At the same time I have not been less careful to avoid drawing general conclusions from only a limited number of facts. Should these conclusions prove fewer and of less importance than might be expected, such defects will, I trust, be regarded with indulgence, at least by those who are aware of the difficulty of conducting a series of physiological experiments, of the time which they necessarily occupy, of the numerous sources of fallacy and failure which exist, and of the laborious attention to the minutest circumstances which is in consequence necessary, in order to avoid being led into error.

II. *Experiments with the Woorara.*

In a former experiment, I succeeded in recovering an animal which was apparently dead from the influence of the essential oil of bitter almonds, by continuing respiration artificially until the impression of the poison upon the brain had ceased; while a similar experiment on an animal under the influence of the woorara, was not attended with the same success. Some circumstances led me to believe that the result of the experiment with the woorara might have been different, if it had been made with certain precautions; but I was unable at that time to repeat it, in consequence of my stock of the poison being exhausted. I have

since, however, been able to procure a fresh supply; and I shall relate two experiments which I have made with it. In one of these an animal apparently dead from the woorara was made to recover, notwithstanding the functions of the brain appeared to be wholly suspended for a very long period of time; in the other, though ultimate recovery did not take place, the circulation was maintained for several hours after the brain had ceased to perform its office.

Exp. 1. Some woorara was inserted into a wound in a young cat. She became affected by it in a few minutes, and lay in a drowsy and half-sensible state, in which she continued at the end of 1 hour and 15 minutes, when the application of the poison was repeated. In 4 minutes after the second application, respiration had entirely ceased, and the animal appeared to be dead; but the heart was still felt acting about 140 times in a minute. She was placed in a temperature of 85° of Fahrenheit's thermometer, and the lungs were artificially inflated about 40 times in a minute.

The heart continued acting regularly.

When the artificial respiration had been kept up during 40 minutes, the pupils of the eyes were observed to contract and dilate on the increase or diminution of light; saliva had flowed from the mouth, and a small quantity of tears was collected between the eye and eyelids; but the animal still continued perfectly motionless and insensible.

At the end of 1 hour and 40 minutes from the same period, there were slight involuntary contractions of the muscles, and every now and then there was an effort to breathe. The involuntary motions continued, and the efforts to breathe became more frequent. At the end of another hour, the animal, for the first time, gave some signs of sensibility when roused, and made spontaneous efforts to breathe 22 times in a minute. The artificial respiration was discontinued. She lay as if in a state of profound sleep, for 40 minutes more, when she suddenly awoke, and walked away. On the following day she appeared slightly indisposed; but she gradually recovered, and is at this time still alive and in health.

Exp. 2. Some woorara was applied to a wound in a rabbit. The animal was apparently dead in 4 minutes after the application of the poison; but the heart continued acting. He was placed in a temperature of 90°, and the lungs were artificially inflated. The heart continued to act about 150 times in a minute. For more than three hours the pulse was strong and regular; after this it became feeble and irregular; and at the end of another hour the circulation had entirely ceased. During this time there was no appearance of returning sensibility.

The circulation of the blood may be maintained in an animal from whom the brain has been removed, for a considerable but not for an unlimited time. We may conclude that, in the last of these experiments, the animal did not recover, because the influence of the poison continued beyond the time during which the circulation may be maintained without the brain.*

III. *On the Effects of Arsenic.*

When an animal is killed by arsenic taken internally, the stomach is found bearing marks of inflammation; and it is a very general opinion, 1. That this inflammation is the cause of death. 2. That it is the consequence of the actual contact of the arsenic with the internal coat of the stomach. But in several instances I have found the inflammation of the stomach so slight, that on a superficial examination it might have been easily overlooked; and in most of my experiments with this poison, death has taken place in too short a time for it to be considered as the result of inflammation; and hence we may conclude that the first of these opinions is incorrect, at least as a general proposition.

Many circumstances conspire to show that the second of these opinions also is unfounded.

In whatever way the poison is administered, the inflammation is confined to the stomach and intestines; I have never seen any appearance of it in the pharynx or œsophagus.

* See Additional Note G, p. 87.

Mr. Home informed me that in an experiment made by Mr. Hunter and himself, in which arsenic was applied to a wound in a dog, the animal died in twenty-four hours, and the stomach was found to be considerably inflamed.

I repeated this experiment several times, taking the precaution always of applying a bandage to prevent the animal licking the wound. The result was, that the inflammation of the stomach was commonly more violent and more immediate than when the poison was administered internally, and that it preceded any appearance of inflammation of the wound.* Some experiments are already before the public which led me to conclude that vegetable poisons, when applied to wounded surfaces, affect the system by passing into the circulation through the divided veins. From this analogy, and from all the circumstances just mentioned, it may be inferred that arsenic, in whatever way it is administered, does not produce its effects even on the stomach until it is carried into the blood.

But the blood is not necessary to life, except so far as a constant supply of it in its healthy state is necessary for the maintenance of the functions of the vital organs. The next object of inquiry therefore is, when arsenic has entered the circulation, on what organs does it operate so as to occasion death?

When arsenic is applied to an ulcerated surface, it produces a slough, not by acting chemically, like caustics in general, but by destroying the vitality of the part to which it is applied, independently of chemical action. This led me at first to suppose that, when arsenic has passed into the circulation, death is the consequence, not so much of the poison disturbing the functions of any particular organ, as of its destroying at once the vitality of every part of the system. The following circumstances, however,

* Since the greater part of my experiments on this subject were made, I have seen an account of an inaugural Dissertation on the Effects of Arsenic, by Dr. Jaëger of Stutgard. Dr. Jaëger has come to conclusions similar to those above stated, that in an animal killed by arsenic, the inflammation of the stomach is not the cause of death, and that the poison does not produce its fatal effects until it has entered the circulation. I have to regret that I have had no opportunity of seeing the original of this dissertation.

seem to show that this opinion is erroneous. In an animal under the full influence of arsenic, even to the instant of death, some of the secretions, as those of the kidneys, stomach, and intestines, continue to take place in large quantity; and the muscles are capable of being excited after death to distinct and powerful contractions by means of the voltaic battery.

Exp. 3. Seven grains of the white oxide of arsenic were applied to a wound in the back of a rabbit.

In a few minutes he was languid, and the respirations were small and frequent. The pulse was feeble, and after a little time could not be felt. The hind legs became paralysed.* He grew insensible, and lay motionless, but with occasional convulsions. At the end of 53 minutes from the time of the arsenic being applied, he was apparently dead; but on opening the thorax, the heart was found still acting, though very slowly and feebly. A tube was introduced into the trachea, and the lungs were artificially inflated; but this appeared to have no effect in prolonging the heart's action. On dissection, the inner membrane of the stomach was found slightly inflamed.

Exp. 4. Two drachms of arseniac acid, dissolved in six ounces of water, were injected into the stomach of a dog by means of a tube of elastic gum, passed down the œsophagus. In 3 minutes he vomited a small quantity of mucus; and this occurred again several times. The pulse became less frequent, and occasionally intermitted. At the end of 35 minutes, the hind legs were paralysed, and he lay in a half-sensible state. At the end of 45 minutes he was less sensible, the pupils of the eyes were dilated, the pulse had fallen from 140 to 70 in a minute, and the inter-

* I have observed that where the functions of the brain are disturbed, paralysis first takes place in the muscles of the hind legs; afterwards in those of the trunk and fore legs; and last of all in the muscles of the ears and face. These facts seem to show that the influence of the brain, like that of the heart, is not propagated with the same facility to the distant as to the near organs; and this is further confirmed by cases of disease which occasionally occur, in which although the paralysis is confined to the lower half of the body, the morbid appearances met with on dissection are confined to the brain.

missions were frequent. After this he became quite insensible, convulsions took place, and, at the end of 50 minutes from the beginning of the experiment, he died.

On opening the thorax immediately after death, tremulous contractions of the heart were observed; but not sufficient to maintain the circulation. The stomach and intestines contained a large quantity of mucous fluid, and their internal membrane was highly inflamed.

These experiments were repeated, and the results, in all essential circumstances, were the same. The symptoms produced were: 1. Paralysis of the hind legs, and afterwards of the other parts of the body; convulsions; dilatation of the pupils of the eyes; insensibility: all of which indicate disturbance of the functions of the brain. 2. A feeble, slow, intermitting pulse, indicating disturbance of the functions of the heart. Where the heart has continued to act after apparent death, I have never, in any one instance, been able to prolong its action by means of artificial respiration. 3. Pain in the region of the abdomen; preternatural secretion of mucus from the alimentary canal; sickness and vomiting in those animals which are capable of vomiting; symptoms which arise from the action of the poison on the stomach and intestines. There is no difference in the effects of arsenic, whether it is employed in the form of oxide, or of arseniac acid, except that the latter is a more active preparation. When arsenic is applied to a wound, the symptoms take place sooner than when it is given internally; but their nature is the same.

The symptoms produced by arsenic may be referred to the influence of the poison on the nervous system, the heart,* and the

* When I say that a poison acts on the heart, I do not mean to imply that it necessarily must act directly on the muscular fibres of that organ. It is highly probable, that the heart is affected only through the medium of its nerves; but the affection of the heart is so far independent of the affection of the nervous system generally, that the circulation may cease, although the functions of the brain are not suspended, and the functions of the brain may be wholly suspended without the circulation being at all disturbed. In proof of the first of these propositions, I may refer to my former experiments on the upas antiar, in which the sensibility of the animal continued to the very instant of death; and

alimentary canal. As of these the two former only are concerned in those functions which are directly necessary to life, and as the alimentary canal is often affected only in a slight degree, we must consider the affection of the heart and nervous system as being the immediate cause of death.

In every experiment which I have made with arsenic there were evident marks of the influence of the poison on all the organs which have been mentioned; but they were not in all cases affected in the same relative degree. In the dog, the affection of the heart appeared to predominate over that of the brain; and on examining the thorax, immediately after death, this organ was found to have ceased acting, and in a distended state. In the rabbit, the affection of the brain appeared to predominate over that of the heart, and the latter was usually found acting feebly, after the functions of the brain had entirely ceased. In the rabbit, the effects produced by the arsenic on the stomach and intestines were usually less marked than in carnivorous animals.

The action of arsenic on the system is less simple than that of the majority of vegetable poisons. As it acts on different organs, it occasions different orders of symptoms, and as the affection of one or another organ predominates, so there is some variety in the symptoms produced even in individual animals of the same species.

In animals killed by arsenic, the blood is usually found fluid in the heart and vessels after death; but otherwise all the morbid appearances met with on dissection are confined to the stomach and intestines. As this is the case, and as the affection of these organs is, in many respects, very remarkable, I shall mention the result of my observations on this subject.

In many cases where death takes place, there is only a very slight degree of inflammation of the alimentary canal: in other cases the inflammation is considerable. It generally begins very

respiration, which is under the influence of the brain, continued even after the heart had ceased to act. In proof of the second, I may refer, among many others, to the experiments detailed in the Croonian Lecture for 1810.

soon after the poison is administered, and is greater or less according to the time which elapses before the animal dies. Under the same circumstances, it is, as I have already observed, less in rabbits than in carnivorous animals. The inflammation is greatest in the stomach and intestines; but it usually extends also over the whole intestine. I have never observed inflammation of the œsophagus. It *is greater in degree and more speedy in taking place, when arsenic is applied to a wound than when it is taken into the stomach.* The inflamed parts are in general universally red, at other times they are red only in spots. The principal vessels leading to the stomach and intestines are much dilated, and turgid with blood; but the inflammation is usually confined to the mucous membrane of these viscera, which assumes a florid red colour, becomes soft and pulpy, and is separable without much difficulty from the cellular coat, the latter presenting its natural appearance. In some instances, there are small spots of extravasated blood on the inner surface of the mucous membrane, or immediately beneath it, and this occurs independently of vomiting. I have never, in any of my experiments, found ulceration or sloughing of the stomach or intestine; but if the animal survives for a certain length of time, after the inflammation has begun, it is reasonable to conclude that it may terminate in one or other of these ways.

I am disposed to believe that sloughing is very seldom, if ever, the direct consequence of the application of arsenic to the stomach or intestines. Arsenic applied to an ulcer will occasion a slough; but its action in doing this is very slow. When I have applied the white oxide of arsenic to a wound, though the animal has sometimes lived three or four hours afterwards, and though violent inflammation has taken place in the stomach and intestines, I have never seen any preternatural appearance in the part to which it was applied, except a slight effusion of serum into the cellular membrane. The very copious secretion of mucus and watery fluid which arsenic speedily produces from the stomach and intestines, separates it from actual contact with the inner surface

of these organs, even though taken in large quantity and in substance; and, in animals which are capable of vomiting, by much the greater part is rejected from the stomach very soon after it has been taken in. Hence, though a few particles of arsenic are sometimes found entangled in the mucus, or in the coagulum of extravasated blood, and adhering to the inner surface of the stomach, I have never seen it in such a quantity as might be supposed capable of destroying the vitality of the parts with which it had been in contact. In one instance, where a dog had swallowed a large quantity of arsenic in substance, a brown spot, about an inch in diameter, was observed after death on the inner surface of the cardiac extremity of the stomach, having so much of the appearance of a slough, that at first I had no doubt of it being so; but on examination, this proved to be only a thin layer of dark-coloured coagulum of blood, adhering very firmly to the surface of the mucous membrane, and having a few particles of arsenic entangled in it. On removing this, the mucous membrane still appeared of a dark colour; but this also was found to arise from a thin layer of coagulum of blood between it and the cellular coat. The mucous membrane itself was inflamed; but otherwise in a natural state. I have observed a similar appearance, but occupying a less extent of surface, several times. In the Hunterian Museum there is a human stomach, which was preserved to show what was considered as a slough produced by the action of arsenic. On examining this preparation, I found that the dark-coloured spot, which had been supposed to be a slough, was precisely of the same nature with that just described.

Although the affection of the stomach and intestines from arsenic is not the cause of death, under ordinary circumstances, it is reasonable to conclude, that it may be so in some instances, if the animal survives the effects produced on the organs more immediately necessary to life. Mr. Henry Earle informed me of an instance, in which this appeared to be the case. A woman in St. Bartholomew's Hospital, who had taken arsenic, recovered of the immediate symptoms, but died at the end of four or five days.

On examination after death, extensive ulcerations were found of the mucous membrane of the stomach and intestines, which we can hardly doubt to have been the cause of death.

It is an important matter of inquiry, as connected with judicial medicine, how far may the examination of the body, after death, enable us to decide, whether an animal has died of the effects of arsenic? On this subject, however, I have only a few remarks to make.

The inflammation from arsenic, occupying in general the whole of the stomach and intestine, is more extensive than that from any other poison with which I am acquainted. It does not, as I have already stated, affect the pharynx or œsophagus, and this circumstance distinguishes it from the inflammation occasioned by the actual contact of irritating applications.

In my experiments I have not obtained much information from the examination of the contents of the stomach after death. When arsenic has been taken in substance, small particles of it are frequently found entangled in the mucus, or in the extravasated blood; but where this was not the case, I have never known, in an animal capable of vomiting, that arsenic could be detected in the stomach afterwards. As some substances, when taken internally, are separated from the blood very soon afterwards with the urine, I thought it probable that arsenic might be separated with the urine also; but Mr. Brande (to whom I am indebted for assistance on the present, as I have been on many other occasions) could never detect the smallest trace of arsenic in it.*

IV. *Experiments with the Muriate of Barytes.*

When barytes is taken into the stomach, or applied to a wound, it is capable of destroying life; but when in its uncombined state, its action is very slow. The muriate of barytes, which is much more soluble than the pure earth, is (probably on this account) a much more active poison.

Exp. 5. Ten grains of muriate of barytes rubbed very fine, and

* See Additional Note H, p. 88.

moistened with two drops of water, were applied to two wounds in the thigh and side of a rabbit. In 4 minutes he was evidently under the influence of the poison. In a short time he became giddy: then his hind legs were paralysed; and he gradually fell into a state of insensibility, with dilated pupils, and lay in general motionless, but with occasional convulsions. The pulse beat 150 in a minute, but feebly, and it occasionally intermitted. He was apparently dead in 20 minutes from the time of the application of the poison; but on opening the chest, the heart was found still acting, and nearly 3 minutes elapsed before its action had entirely ceased.

Exp. 6. An ounce and a half of saturated solution of muriate of barytes was injected into the stomach of a full-grown cat, by means of an elastic gum tube. In a few minutes it operated as an emetic. The animal became giddy, afterwards insensible, and lay with dilated pupils in general motionless, but with occasional convulsions. At the end of 65 minutes from the beginning of the experiment, he was apparently dead; but the heart was still felt through the ribs, acting 100 times in a minute. A tube was introduced into the trachea, and the lungs were inflated about 36 times in a minute; but the pulse sunk notwithstanding, and at the end of 7 minutes the circulation had entirely ceased.

From these experiments, I was led to conclude, that the principal action of the muriate of barytes is on the brain; but, in the first the pulse was feeble and intermitting; in the second, although the artificial respiration was made with the greatest care, the circulation could not be maintained longer than a few minutes. These circumstances led me to suspect that, although this poison operates principally on the brain, it operates in some degree on the heart also. Further experiments confirmed this suspicion. In some of them the pulse soon became so feeble that it could be scarcely felt; and its intermissions were more frequent; but in all cases the heart continued to act after respiration had ceased; and the cessation of the functions of the brain was therefore always the immediate cause of death. When I employed artificial respira-

tion, after death had apparently taken place, I seldom was able to prolong the heart's action beyond a few minutes. In one case only it was maintained for three quarters of an hour. I never by these means succeeded in restoring the animal to life, although the experiments were made with the greatest care and in a warm temperature. In some instances, after the artificial respiration had been kept up for some time, there were signs of the functions of the brain being in some degree restored; but the pulse, notwithstanding, continued to diminish in strength and frequency, and ultimately ceased. I shall detail one of these experiments, as it serves to illustrate the double action of this poison on the nervous and vascular systems.

Exp. 7. Some muriate of barytes was applied to a wound in the side of a rabbit. The usual symptoms took place, and at the end of an hour the animal was apparently dead; but the heart still continued to contract. He was placed in a temperature of 80°, and a tube being introduced into the nostril, the lungs were artificially inflated about 36 times in a minute.

When the artificial respiration had been maintained for 4 minutes, he appeared to be recovering; he breathed voluntarily 100 times in a minute, and showed signs of sensibility. The artificial respiration was discontinued. The voluntary respiration continued about 9 minutes, when it had ceased, and the animal was again apparently dead; but the pulse continued strong and frequent. The lungs were again artificially inflated. At the end of 4 minutes the animal once more breathed voluntarily 100 times in a minute, and repeatedly moved his limbs and eyelids. The pulse became slower and more feeble.

In a few minutes the voluntary respiration again ceased, and the artificial respiration was resumed. The pulse had fallen to 100, and was feeble. The animal again breathed voluntarily; but he ceased to do so at the end of 5 minutes. The lungs were inflated as before; but he did not give any sign of life, nor was the pulse felt afterwards. On opening the thorax, the heart was found to have entirely ceased acting.

A probe having been introduced into the substance of the spinal chord, it was found that by means of the voltaic battery, powerful contractions might be excited, not only of the voluntary muscles, but also of the heart and intestines; from which it may be inferred, that the muriate of barytes, like arsenic, affects the circulation by rendering the heart insensible to the usual stimulus, and not by destroying altogether the power of muscular contraction.

The muriate of barytes affects the stomach, but in a less degree than arsenic. It operates as an emetic in animals that are capable of vomiting; but sooner when taken internally, than when applied to a wound. In general, but not constantly, there are marks of inflammation of the inner membrane of the stomach, but not of the intestine. In many instances there is a thin layer of dark-coloured coagulum of blood lining the whole inner surface of the stomach, and adhering very closely to it, so as to have a good deal of the appearance of a slough; and this is independent of vomiting, as, where I met with it, it occurred in rabbits.

The same circumstances, from which it may be inferred that arsenic does not produce its deleterious effects until it has passed into the same circulation, lead also to that conclusion with regard to the muriate of barytes.

V. *On the Effects of the Emetic Tartar.*

The effects of the emetic tartar so much resemble those of arsenic and of muriate of barytes in essential circumstances, that it would be needless to enter into a detail of the individual experiments made with this poison.

When applied to a wound in animals, which are capable of vomiting, it usually, but not constantly, operates very speedily as an emetic; otherwise, I have found no material difference in the symptoms produced in the different species of animals which I have been in the habit of employing as the subjects of experiment. The symptoms are paralysis, drowsiness, and at last complete insensibility; the pulse becomes feeble; the heart continues to act after apparent death; its action may be maintained by means of

artificial respiration, but never for a longer period than a few minutes: so that it appears that this poison acts on the heart as well as on the brain; but that its principal action is on the latter. Both the voluntary and involuntary muscles may be made to contract after death, by means of voltaic electricity. The stomach sometimes bears the marks of inflammation; but at other times it has its natural appearance. I have never seen any appearance of inflammation of the intestines. The length of time which elapses from the application of the poison to the death of the animal varies. In some instances, it is not more than three quarters of an hour; but in others, it is two or three hours, or even longer.

When a solution of emetic tartar was injected into the stomach of a rabbit, the same symptoms took place as when it was applied to a wound.

VI. *On the Effects of the Corrosive Sublimate.*

When this poison is taken internally in very small and repeated doses, it is absorbed into the circulation, and produces on the system those peculiar effects which are produced by other preparations of mercury. If it passes into the circulation in larger quantity, it excites inflammation of some part of the alimentary canal, the termination of which may vary accordingly as it exists in a greater or less degree. When taken in a larger quantity still, it occasions death in a very short space of time. I had found, that if applied to a wounded surface, it produced a slough of the part to which it was applied, without occasioning any affection of the general system. This led me to conclude that the effects of it, taken internally, and in a *large* quantity, depend on its local action on the stomach, and that they are not connected with the absorption of it into the circulation. The following experiments appear to confirm this opinion.

Exp. 8. Six grains of corrosive sublimate, dissolved in six drachms of distilled water, were injected into the stomach of a rabbit, by means of an elastic gum tube. No immediate symptoms followed the injection; the animal made no expression of

pain; but in three minutes he became insensible; was convulsed; and in four minutes and a half from the time of the injection being made he died. Tremulous contractions of the voluntary muscles continued for some time afterwards. On opening the thorax, the heart was found to have entirely ceased acting, and the blood in the cavities of the left side was of a scarlet colour. The stomach was much distended. The pyloric and cardiac portions were separated from each other by a strong muscular contraction. The contents of the former were firm and solid, and in every respect resembled the usual contents of the stomach; while those of the cardiac portion consisted of the food of the animal much diluted by fluid; so that the solution which had been injected, appeared to be confined to the cardiac portion of the stomach, and to be prevented entering the pyloric portion by the muscular contraction in the centre.

In the pyloric portion of the stomach the mucous membrane had its natural appearance; but in the cardiac portion it was of a dark grey colour, was readily torn, and peeled off; and in some parts its texture was completely destroyed, so that it appeared like a pulp, on removing which the muscular and peritonæal coats were exposed.

The repetition of the experiment was attended with similar results. The alteration of the texture of the internal membrane was evidently occasioned by its having been chemically acted on by the corrosive sublimate injected into it. When the injection is made into the stomach of a dead rabbit, precisely the same effects are produced, except that, as the middle contraction is here wanting, the appearances are not confined in the same degree to the cardiac portion.

Exp. 9. A scruple of corrosive sublimate, dissolved in six drachms of distilled water, was injected into the stomach of a full-grown cat. For the first five minutes no symptoms were produced. After this the poison operated twice as an emetic. The animal was restless and excited, then gradually became insensible, and lay on one side motionless, with the pupils of the eyes dilated. The respiration was laborious, and the pulse could not be felt.

Twenty-five minutes after the poison had been injected, there was a convulsive action of the voluntary muscles, and death immediately ensued. On opening the thorax immediately afterwards, the heart was seen still contracting, but very feebly.

The stomach was found perfectly empty and contracted. The mucous membrane was everywhere of a dark grey colour. It had lost its natural texture, and was readily torn and separated from the muscular coat. The internal membrane of the duodenum had a similar appearance, but in a less degree, for nearly three inches from the pylorus. In the situation of the pylorus, the effects of the poison were less apparent than elsewhere.

The peculiar state of the internal membrane of the stomach, in this experiment as well as in the last, appears to have been occasioned by the chemical action of the poison on it. When I injected a solution of corrosive sublimate into the stomach of a dead cat, and retained it there for a few minutes, a similar alteration of the texture of the internal membrane took place; but it assumed a lighter grey colour. The difference of colour may be explained by the vessels in the one case having been empty, and in the other case having been distended with blood at the time of the injection being made.

The destruction of the substance of the internal membrane of the stomach precludes the idea of the poison having been absorbed into the circulation. We must conclude that death was the consequence of the chemical action of the poison on the stomach. This organ, however, is not directly necessary to life, since its functions, under certain circumstances, are suspended for hours, or even for days, without death being produced. Although the stomach was the part primarily affected, the immediate cause of death must be looked for in the cessation of the functions of one or more of those organs whose constant action is necessary to life. From the scarlet colour of the blood in the left side of the heart, in the experiment on the rabbit, we may conclude that the functions of the lungs were not affected; but the affection of the heart and brain is proved by the convulsions, the insensibility, the affection of the

pulse in both experiments, and the sudden cessation of the heart's action in the first, and we may therefore be justified in concluding, that the immediate cause of death was in both of these organs. As the effects produced appear to have been independent of absorption, we may presume that the heart, as well as the brain, was acted on through the medium of the nerves.

That a sudden and violent injury of the stomach should be capable of thus speedily proving fatal is not surprising, when we consider the powerful sympathy between it and the organs on which life more immediately depends, and the existence of which many circumstances in disease daily demonstrate to us.

VII. *Conclusion.*

The facts which have been stated appear to lead to the following conclusions respecting the action of the mineral poisons, which were employed in the foregoing experiments.

1. Arsenic, the emetic tartar, and the muriate of barytes do not produce their deleterious effects until they have passed into the circulation.

2. All of these poisons occasion disorder of the functions of the heart, brain, and alimentary canal; but they do not all affect these organs in the same relative degree.

3. Arsenic operates on the alimentary canal in a greater degree than either the emetic tartar, or the muriate of barytes. The heart is affected more by arsenic than by the emetic tartar, and more by this last than by the muriate of barytes.

4. The corrosive sublimate, when taken internally in large quantity, occasions death by acting chemically on the mucous membrane of the stomach, so as to destroy its texture; the organs more immediately necessary to life being affected in consequence of their sympathy with the stomach.

In making the comparison between them, we may observe that the effects of mineral are less simple than those of the generality of vegetable poisons; and it appears that when once an animal is affected by the former, there is much less chance of his recovery than when he is affected by the latter.

ADDITIONAL NOTES.

Note A. Page 26.

In the experiments related in my two memoirs on the production of animal heat, it has been seen that the animals in which the circulation of the blood was maintained by means of artificial respiration after the removal of the brain, or the destruction of its functions by the agency of a narcotic poison, cooled more rapidly than those in which the circulation had entirely ceased.

The general result as to the loss of heat in animals under these circumstances has been confirmed by the observations of other experimentalists, especially of Dr. Chossat, M. Le Gallois, and Dr. Wilson Philip. It is, however, stated by M. Le Gallois, that in his experiments the loss of heat was not uniform, and that while in some instances it was greater in the animal under the influence of artificial respiration than in the dead animal, in other instances it was the reverse, the latter having preserved a somewhat higher temperature than the former.

I know that my observations were made with great care, at the same time that they were confirmed by those who assisted me on these occasions; and I do not doubt that those of M. Le Gallois were equally correct. Dr. Wilson Philip has pointed out what is probably one cause of the difference between us in the difference in the quantities of air impelled into the lungs. In a rabbit in which the lungs were inflated about 30 times in a minute (this being about the ordinary number of respirations in a full-grown animal of this species), the loss of heat was greater than in the dead rabbit; but when the process was repeated only 12 times in a minute, the proportion was reversed, and the dead animal cooled somewhat faster than the other.

One effect of the admission of cold air into the lungs, whether by the natural process of respiration, or by respiration artificially performed, must be to carry off from the animal a certain portion of heat; and this effect must be produced to a greater extent if, when respiration is artificially performed, a larger quantity of cold air enters the lungs than that which

they receive under ordinary circumstances. It is difficult to estimate the precise quantity of air which enters the lungs when they are artificially inflated; and I must therefore admit that one of the conclusions which I ventured to draw from my experiments—namely, that where the influence of the brain is withdrawn, no heat whatever is generated—may not be strictly and rigidly correct. The difference, however, in this respect between these two modes of respiration, where the experiments are conducted with any degree of care, is certainly but trifling, and not such as will account for the great diminution of temperature which takes place. In confirmation of what is now stated, I may refer to the following experiment made by Dr. Chossat.* Having perforated the cranium of a dog, by means of a small trephine, he made a section of the brain immediately in front of the *Pons Varolii*, so as to intercept the communication of the nervous influence from the rest of the brain to the last-mentioned organ. The animal continued to breathe by his natural efforts, the pulse and respiration being for many hours as frequent as under ordinary circumstances. Nevertheless at the end of four hours he had lost 9·7° (Centigrade) of heat; while, in another experiment, a dog, a very little larger, which had been killed by the division of the spinal chord in the upper part of the neck, lost 8·8° (Centigrade) in the same period of time. It may be further observed, that my experiments were all made during the warm weather of summer, when the cooling property of the air must have been much less than in the cold season of the year, and that, whatever might have been the influence in this respect of the artificial respiration in my first series of experiments, it must have been very trifling in my second series, not only because these last experiments having been made in a close vessel, the cold air inspired must necessarily have been always mixed with a certain portion of the air expired previously, but also because, from the relative position of the animal and the aperture in the upright portion of the tube, the air drawn into the latter by the elasticity of the gum-bottle, and afterwards impelled into the lungs, must have had communicated to it a large portion of the heat which the entire body of the animal was gradually losing.

According to the then received theory of the production of animal heat, the loss of heat in these experiments cannot be accounted for, except by assuming that there was a very much smaller quantity of oxygen consumed, and of carbonic acid generated, than where respiration is performed under ordinary circumstances. Such an assumption, however, even as to my first series of experiments, is not supported by the facts. The dark venous blood, after it had passed through the lungs, underwent the usual change

* Mémoire sur l'Influence du Système Nerveux sur la Chaleur Animale, p. 15. 1820.

of colour; and not only the contractions of the heart were regularly performed, but, in dogs especially, there seemed to be actually an increased irritability of the voluntary muscles, continued, not for a short time, but even for an hour and a half, and until the temperature of the rectum had fallen to 15° (Fahrenheit) below the natural standard. These muscular contractions were most remarkable, in one of the experiments related in my first paper on poisons, after the injection of the infusion of tobacco into the intestine, keeping not only the extremities but the whole body of the animal in a state of constant motion, and lasting for some minutes after the artificial respiration had been discontinued and the blood had ceased to circulate.

It was with a view to obtain more exact information as to the quantity of oxygen consumed under these circumstances that my second series of experiments was instituted. The apparatus employed in the investigation proved to be well adapted for the intended purpose; the experiments were carefully made; and the air, after they were concluded, having been always examined by my friend Professor Brande, there can be no doubt as to the accuracy with which the proportion of carbonic acid in it was ascertained.

These last-mentioned experiments were repeated, in the year following that in which an account of them was published in the 'Philosophical Transactions,' by M. Le Gallois; with some considerable modifications, however, which I shall notice hereafter. In his third memoir on animal heat, this philosopher, after having described his own want of success in contriving an apparatus for the purpose of measuring the quantity of oxygen consumed by animals breathing by artificial means, observes: 'M. Brodie a trouvé le moyen de pratiquer l'insufflation pulmonaire dans des vaisseaux fermés à une manière à la fois sure et commode. L'appareil qu'il a imaginé pour cela est fort simple, et réunit toutes les conditions, qu'on pourrait désirer pour le succès de l'expérience.'

In using this apparatus, it has been seen that I employed rabbits of nearly the same size, occupying the space of from 48 to 50 cubic inches. My three first experiments were intended to determine the quantity of carbonic acid exhaled from the lungs of rabbits of this size, breathing under natural circumstances. In one of them it proved to be 25·3 cubic inches, in each of the others 28·22 cubic inches in half an hour, giving an average of about 27·25 cubic inches of carbonic acid in this space of time. In my next experiment, a rabbit, in which the spinal chord, nerves, and vessels had been so divided as to produce the same effect as decapitation, the circulation having been afterwards maintained by artificial respiration, generated 20·2 cubic inches in half an hour. The formation of carbonic acid was, therefore, less than that by the animal in its natural condition, in the proportion of about 20 to 27. But in this experiment an amount

of hæmorrhage took place, which, although immediately suppressed, seemed to afford a sufficient explanation of the difference. In order to avoid this source of error, my subsequent experiments were made in a way in which no loss of blood could ensue, the functions of the brain being destroyed, not by any mechanical operation, but by means of a narcotic poison. The result was that the carbonic acid generated was fully equal to that which rabbits of the same size supply under natural circumstances.

In the experiments which M. Le Gallois instituted with my apparatus, he employed very young rabbits, much smaller than those which had been employed by myself. Instead of placing them under the influence of a narcotic poison, or of decapitation, in some of them he merely made a section of the spinal chord immediately below the cranium; while in others, besides dividing the chord, he destroyed the texture of the brain, by introducing an instrument into the cranium, through the great foramen of the occiput. After having inflated the lungs for 30 minutes, he found that the carbonic acid generated was, in the majority of instances, considerably less than that which was generated by the same animals breathing naturally; and comparing these experiments with those which I had made with the narcotised animals, he states that the results of his experiments do not correspond with those obtained by myself. I cannot, however, admit the justice of this comparison. I attributed the smaller production of carbonic acid in the first of my experiments to the loss of blood consequent on the division of the spinal chord and of the vessels and nerves in the neck. We know that the section of the spinal chord below the occiput is in itself sufficient to cause immediately a certain degree of hæmorrhage from the muscles of the neck, and from the arteries, veins, and sinuses within the theca vertebralis. But where an instrument is introduced through the foramen of the occiput, for the purpose of destroying the texture of the brain, there cannot fail to be a still larger hæmorrhage, from the laceration of the arterial circle formed by the carotid and vertebral arteries in the base of the brain. In either case the hæmorrhage would probably continue for some time after the artificial respiration was begun, and must considerably influence the result of the experiment. As I have already stated, it was to avoid a similar source of error that I had recourse to the method of destroying the functions of the brain by means of narcotic poison, and it is plain that in comparing the results of our respective experiments, it is not with these last, but only with the first of my experiments, that the comparison should be made.

The experiments of M. Le Gallois having been made on much younger and smaller animals than those employed by myself, the question is not as to the absolute quantity of air consumed where the influence of the brain is destroyed, but as to the proportion which it bears to the air consumed by animals of the same kind and size breathing under ordinary circum-

stances. Of his experiments, five in number, the results were very different. In one instance, a rabbit which, breathing under natural circumstances, had generated 142·43 cubic centimetres in 30 minutes, when under the influence of artificial respiration generated as much as 137·8 cubic centimetres in the same space of time; while in another the corresponding numbers were 259·8 and 206·5; and 209·16 and 109·99 in a third. This difference is probably to be attributed, in great measure, to the greater or less extent of the internal hæmorrhage. If we take the average of the whole of M. Le Gallois's experiments, we find that the carbonic acid produced by natural respiration, in 30 minutes, was 233·94, and that by artificial respiration 181·67 cubic centimetres; the proportion of the latter to the former being actually larger than it was in the corresponding experiment made by myself.* Taking all these circumstances into consideration, I apprehend that the results obtained by M. Le Gallois, instead of contradicting, must be considered as confirming those which I had obtained previously, and as justifying the opinion that if he had conducted his experiments so as to avoid the disturbing influences connected with the mechanical destruction of the functions of the brain, he would have found, as I did, that the exhalation of carbonic acid, when respiration was performed artificially, fully equalled that which took place when the animal was in its natural condition.

In pursuing these investigations, I assumed that the carbonic acid generated in respiration, may be taken as the measure of the oxygen consumed, this being the conclusion to which Messrs. Allen and Pepys were led by their carefully conducted investigations. It has, however, been stated by others, that a portion of oxygen disappears beyond that which is replaced by the carbonic acid, and M. Le Gallois endeavoured to ascertain to what extent this loss of oxygen takes place. The quantity, according to his statement, was so much greater than that which has been found by others, that it is very difficult to avoid the suspicion that there was some error in the observations. However, admitting them to be correct, as (the experiments having been made in the same way, and with the same apparatus), whatever oxygen was absorbed in his experiments, a corresponding quantity must have been absorbed in mine, and as, according to M. Le Gallois's statements, the proportion of oxygen absorbed by animals respiring naturally, and by those respiring artificially, though differing in individual instances, did not, on an average, materially differ from that of the carbonic acid generated, the remarks which I have made

* If we suppose 100 to represent the quantity of air consumed in natural respiration, the proportion borne by that to the air consumed in artificial respiration in my first experiment after the division of the spinal chord, nerves, and vessels in the neck, was nearly as 100 : 74; and in M. Le Gallois's experiments, as 100 : 77.

as to the latter are equally applicable to the former, so that we are led to no different conclusion.

It has been seen that, in my last series of experiments, the animals under the influence of artificial respiration cooled somewhat more rapidly than the dead animals, the difference between them, however, being less than in my former experiments, probably in consequence of their having been carried on in a close vessel, and not in the open air.

It has also been seen that in some of the experiments made by M. Le Gallois with decapitated animals, and described in his first memoir, the animal respiring artificially cooled more rapidly, and in others more slowly, than the dead animal, while in others there was no appreciable difference in this respect between them. But in those described in his last memoir, and made with my apparatus, the dead animal always cooled more slowly than the other, the difference varying from as little as 0·3° Centigrade to as much as 2·3° Centigrade (that is, from a little more than half a degree to about 4° of Fahrenheit) in half an hour.

It certainly may be that the discrepancy in this respect between these last-mentioned experiments on the one hand, and my own and some of M. Le Gallois's earlier experiments on the other hand, may have arisen from the cause pointed out by Dr. Philip, namely, the greater or less degree in which the lungs were inflated. It seems to me, however, that it admits of another and a more probable explanation.

In fact, M. Le Gallois's last experiments were not an exact repetition either of my experiments, or of his own former experiments. In some of them the spinal chord was divided, and the brain was left entire. In others the brain was mechanically disorganised by means of an instrument introduced through the foramen of the occiput. In the former case it is evident that the brain must have retained its influence over the head, and to a certain extent over the rest of the system, by means of the pneumogastric and great sympathetic nerves; and it is by no means certain that the disorganisation of the brain must have been always so complete as wholly to destroy its influence in the latter.* Further experiments,

* Some experiments made by Dr. Enoch Hale (of the United States), are recorded in the 'London Medical and Physical Journal' for 1815, in which, having merely divided the spinal chord immediately below the occiput, and having maintained the action of the heart by artificial respiration, he found that a small degree of heat was still generated. As the brain and nerves in the neck remained entire, it is plain that these experiments are liable to the objection which has been stated above. It may, moreover, be observed that in such experiments it ought to be ascertained afterwards whether the division of the

indeed, are required before this question can be positively determined. The main fact, however, remains the same, namely, that under certain circumstances, there is no relation between the oxygen consumed in respiration and the heat generated, while there is a very close relation between the calorific function and the integrity of the functions of the nervous system. This is, indeed, admitted by M. Le Gallois himself, when he thus expresses himself: 'Il n'y a pas de doute que la puissance nerveuse ne joue un très grand role dans ce phénomène, de même que dans tous ceux qui supposent la vie.' * And again, 'C'est sur la conversion du sang artériel en sang veineuse, et sur le changement de capacité qui l'accompagne, que la puissance nerveuse a une action immédiate. Aussi remarque-t-on que le développement du calorique, soit dans tout le corps, soit dans une partie déterminée, est en raison de l'énergie de cette puissance marquée par l'activité de la circulation.' †

At the time when these researches were instituted the theory enunciated by Lavoisier and La Place was universally received, and no one entertained a doubt that the temperature which a warm-blooded animal possesses above that of the atmosphere was entirely explained by the consumption of oxygen in respiration. Since then further inquiries have been made on the subject by several distinguished chemists; and the observations of M. Dulong, M. Despretz, and very lately those of Messrs. Regnault and Reiset, have confirmed the opinion that this explanation is insufficient, and that whatever the effect of the conversion of oxygen into carbonic acid may be, there must be some other source of animal heat.

I shall conclude this note with adducing some other facts, which lead to the same conclusion, and which indeed seem to be in themselves sufficient to prove that the production of animal heat is a subject which requires still further investigation.

1. The various animals of the class Mammalia have nearly the same temperature, the difference between them being not more than one or two degrees of Fahrenheit's thermometer. There is, however, reason to believe that there is a great difference as to the quantity of oxygen which they consume in respiration. Thus M. Le Gallois found that in the space of three hours a rabbit, weighing 947 grammes, consumed only 2,724 cubic

spinal chord has been complete, as the result of accidental injuries shows that even a partial laceration of the spinal chord may produce total paralysis of the parts below the seat of the injury. In another respect also Dr. Hale's experiments cannot be regarded as a repetition of my own, having been made on dogs; whereas my comparative experiments were all made on rabbits. M. Le Gallois found that young cats produced a small degree of heat after decapitation; and it may possibly be the same with respect to dogs.

* Œuvres de Le Gallois, tome ii. p. 53.

† Ibid. p. 55.

centimetres; while a dog, weighing 917 grammes, consumed 5,503 cubic centimetres; and a cat, weighing 634 grammes, consumed as much as 3,963 cubic centimetres in the same space of time.*

2. In the course of his researches, M. Le Gallois found that living rabbits, merely from being confined in a restrained position on the back, gradually became of a lower temperature; and he observes that if this experiment were continued for a considerable length of time, the cooling process might be carried so far as even to occasion the death of the animal. Supposing that the loss of heat under these circumstances must be connected with a diminished consumption of oxygen in respiration, he repeated the experiments, having placed the animals in an apparatus in which the respired air might be preserved and examined. The result, however, did not correspond with his anticipations; the amount of oxygen consumed being found to vary in different instances, so that it was sometimes much less, and at other times much greater, than under ordinary circumstances. M. Le Gallois attributes the loss of heat in these experiments, partly to the greater effort required for breathing in the position in which the animals were placed, and partly to the exertions of the muscular system generally made to obtain relief from the restraint. Neither of these, however, can be regarded as a satisfactory explanation. The respiration of a man or a horse in rapidly ascending a hill, is carried on with much greater effort than when moving on a plain surface; but the result is not a diminution but an increase of temperature; and the very curious researches of Messrs. Becquerel and Breschet have demonstrated that there is actually a development of heat during muscular contraction. The more probable explanation seems to be that the loss of heat is the consequence of the state of alarm in which the animal is placed, operating on him in the same manner as the same depressing passion operates on the human subject.

3. In the experiments of Messrs. Allen and Pepys † it was found that when the air used in respiration was pure oxygen, a very much larger proportion of carbonic acid was generated than in the respiration of atmospheric air. A guinea-pig, which furnished 0·88 cubic inch of carbonic acid per minute when breathing atmospheric air, furnished 1·48 cubic inch per minute in one experiment, and 1·11 cubic inch in another, when breathing pure oxygen. A corresponding difference, but to a less extent, was observed as to the results of respiration with atmospheric air and that with oxygen gas in the human subject. It does not appear that these experimentalists observed that the increase in the quantity of carbonic acid was attended with any increase of temperature; and in some very curious experiments which were made (by my suggestion) by the

* Œuvres de Le Gallois, tome ii.

† Philosophical Transactions, 1808, pp. 415, 417, 420.

late Mr. S. D. Broughton, and which are recorded in the 'Quarterly Journal of Science,' it was found that the temperature of animals which breathed pure oxygen, not only did not arise above the natural standard, but actually fell considerably below it.

4. While certain læsions of the nervous system cause a diminution of the vital temperature, the following history justifies the conclusion that there are others which may produce the opposite effect, and cause its elevation above the natural standard. A man met with an accident which occasioned a forcible separation of the bodies of the fifth and sixth vertebræ of the neck, attended with an effusion of blood within the theca vertebralis, and a laceration of the lower part of the cervical portion of the spinal chord. It is well known to surgeons, that under such circumstances inspiration is always very imperfectly performed by means of the diaphragm only, without the assistance of the ribs; while, in consequence of the paralysed state of the abdominal muscles, expiration depends altogether on the pressure of the abdominal viscera acting on the relaxed diaphragm. The patient in this instance died at the end of 22 hours from the period of the injury, and for a considerable time previously to his death breathed at very long intervals, the pulse being weak, and the countenance livid. At last there were not more than five or six inspirations in a minute. Nevertheless, when the ball of a small thermometer was placed on the inside of the groin, the quicksilver rose to 111° of Fahrenheit. Immediately after death the temperature was examined in the same situation, and found to be still the same. The case occurred under my care in St. George's Hospital, in the year 1821, at which time Mr. Cæsar Hawkins was house-surgeon; and the facts were observed and noted by Mr. Hawkins and myself, and witnessed by several of the students.

Although the elevation of temperature to so great an extent may not be a very frequent occurrence, cases must be in the recollection of every physician and surgeon, in which, under certain morbid conditions of the nervous system, the natural temperature was fully maintained, at the same time that the respiration was so slow and imperfect as to indicate that the consumption of oxygen in that process must have been greatly diminished. The following observations, illustrative of this subject, are taken from John Hunter's 'Lectures on the Principles of Surgery,' delivered in the year 1786-1787,* and they are of so much interest, in connection with the present inquiry, that I am tempted to extract the whole passage.

'It being discovered that the absolute heat of bodies differs very much in different substances, and perhaps in the same substances differently combined, it was thought that this would account for the production, and continuation, of animal heat. It is supposed that the air which we inspire

* Palmer's edition of the works of John Hunter, vol. i. pp. 282, 283.

has much more absolute heat than the same air has when we expire it, and that the superabundant heat is given to the animal. But this chemical method of accounting for heat will not account for all the varieties in the heat of animals at different times, especially in disease, when the breathing does not equally vary, or correspond with the heat of the animal.

'A remarkable case fell under my observation of a gentleman who was seized with an apoplectic fit. He lay insensible in bed, covered with the blankets. I found his whole body become extremely cold in every part, and continue so for some time, and in a short time become extremely hot. While this was going on for several hours alternately, there was no sensible alteration either in the pulse or in the breathing.

'A man fell from his horse, and pitched on his head, which produced all the symptoms of a violent injury. There was concussion of the brain, and perhaps extravasation of blood, but no fracture could be seen. The pulse was at first 120, but came down to 100, and was strong, full, and rather hard. He was very hot in the skin, but breathed remarkably slow, only one half of the common frequency. His breathing, pulse, and heat, therefore, did not correspond with this theory of heat.

'February, 1781. A boy, about three years old, appeared not quite so well as common, being attacked with a kind of shortness of breathing in the night. It had become exceedingly oppressed about five o'clock on Sunday morning, so difficult that he appeared dying for want of breath. In this state he lay till two o'clock, when I saw him. He was breathing so slowly, that I thought that every breath would be his last—about $2\frac{1}{2}$ or less inspirations in a minute. (The common rate of breathing in such a boy is about 30 inspirations in a minute, and about 20 in a man.) When he drew his breath, it was with a jerk; but his expiration was very slow, generally continuing 5 seconds. I often could not distinguish the pulse; at other times it was manifest, although very faint and slow, not more than 60 in a minute. On tying up the arm the vein did not rise in the least, so that the blood did not go its round. His eyes were turned up under the upper eyelid, while his body had a purple cast, especially the lips, which is easily accounted for, it being owing to the blood not getting the scarlet red in its passage through the lungs, and that whatever it might get there was lost in its slow motion through the arteries of the body. He had a fine warmth on the skin all over the body, although in a room without a fire, not covered with more clothes than common in the month of February, with snow falling at noon.

'Here it cannot be said that the heat of the body, which was neither great nor deficient, could arise from the constant supply furnished by respiration.'

But here two questions will present themselves. If it be not from respiration, from what source is the higher temperature of warm-blooded

animals derived? and where respiration is carried on without maintaining the vital temperature, what becomes of the heat, which under other circumstances is the result of the union of carbon with oxygen gas, and their conversion into carbonic acid? Neither of these problems do I undertake to solve; my object being, as I have observed elsewhere, not to advance opinions, but simply to state some facts which I have met with in the course of my physiological investigations. I venture, however, to offer the following suggestions:—

It has been shown by Mr. Grove* that there is great reason to believe that the physical forces to which we refer the ever-varying phenomena of inorganic nature, such as light, heat, motion, magnetism, and chemical affinity, are in a state of mutual relation; so that under certain circumstances one of these forces is capable of producing, or being converted into, another. And Mr. Grove has further suggested that the principles and mode of reasoning on which his 'observations are founded, may be applied to the organic as well as the inorganic world, and that muscular force, animal and vegetable heat, &c., may and sometimes will be shown to have similar definite correlations.' Supposing these views to be correct, may it not be that the union of carbon with oxygen gas, which, under ordinary circumstances, is immediately followed by the evolution of heat, is, in the living body, productive of a different result (such as the maintenance of the nervous power, or the irritability of the muscles), and that it may thus be only indirectly concerned in the calorific function?

But setting these speculations aside, it may be observed that respiration is only one of many chemical processes which take place in the animal body, some of which may be supposed to cause an evolution of heat, and others to have a directly opposite effect; and if we refer to these, as connected with the higher temperature of warm-blooded animals, we should consider, not what may be the actual quantity produced by any one of them, but what is the amount produced on the whole, after making allowance for that which is wasted by perspiration, and in other ways.

If we cannot, on purely chemical principles, explain why the integrity of the nervous system is necessary to the maintenance of animal heat, neither can we explain the result of those very remarkable experiments lately made by M. Bernard, in which he found that a slight mechanical injury of a certain part of the *medulla oblongata* causes a secretion of sugar by the kidneys; nor why one state of mind augments the secretion of the lachrymal gland, while another deranges the secretions of the stomach and liver.

But may not the fact admit of another explanation? However unsuccessful the attempts actually to identify the nervous power with electricity

* The Correlation of Physical Forces, by W. R. Grove, M.A. F.R.S., 2nd edition, 1850. See also Dr. Carpenter's Memoir 'On the Mutual Relations of the Vital and Physical Forces,' in the 'Philosophical Transactions,' 1850.

may have proved to be, there can be no doubt that in many respects these two forces bear a considerable resemblance to each other. The generation of the nervous power as a consequence of the circulation of arterial blood in the grey matter of the brain and spinal chord; the instantaneous transmission of it through the nerves; sometimes affecting the secretions, and causing the blood to undergo changes in its chemical composition in the various glands, at other times exciting violent contractions of the muscles—these things are very analogous to the effects produced by a voltaic battery; and there seems to be no reason, à priori, why the resemblance should not extend still further, nor why the evolution of heat should not be one of the results of the operation of the nervous power as it is of electricity.

Note B. Page 31.

In my papers on the mode in which death is produced by poisons, I have stated various circumstances which led me to the conclusion that poisons which are applied to wounded surfaces produce their effect by passing into the circulation; and that certain mineral poisons when introduced into the alimentary canal, have a similar mode of operation. There is no doubt that various deleterious (as well as medicinal) agents of vegetable origin, when administered internally, also affect the vital organs in the same manner, by entering the vascular system and being mixed with the circulating blood.

But I have further stated that there is much reason to believe that some of the more active poisons operate in a different manner, and that when applied to mucous membranes they are capable of affecting the nervous centres through the medium of the nerves, and independently of absorption.

On this last point, other physiologists have arrived at a different conclusion, and are of opinion that even those poisons which are the most active, and which seem to produce their effect almost instantaneously, do so, not by an influence transmitted through the nerves, but solely by penetrating the solid tissues, and thus contaminating the blood.

The arguments in favour of this view of the subject have been well stated by Mr. Blake in a memoir published in the 53rd volume of the 'Edinburgh Medical and Surgical Journal.' They are founded on the facility with which the tissues are penetrated by fluid and gaseous bodies, and on the great rapidity of the circulation.

The facts advanced by Mr. Blake are equally interesting and important. There can be no doubt that poisons applied to the tongue may enter into the blood in a very short space of time, and that this must at any rate be one mode in which they act; and that most of the phenomena which occur may be in this manner sufficiently explained.

Nevertheless, other facts may be adduced, which render it doubtful whether the whole of the phenomena admit of this explanation, at the

same time that the analogy of what happens under other circumstances justifies us in regarding the agency of the nerves in transmitting the influence of certain poisons to the vital organs as no improbable hypothesis.

1. The rapidity with which the poison operated in some of my own experiments, in those of Dr. Christison made with the active principle of Hemlock and of M. Magendie and Mr. Taylor with the hydrocyanic acid, is even greater than can be well accounted for otherwise, however rapid the circulation, and however easy the transmission of the poison may be through the substance of the mucous membranes and the tunicks of the blood-vessels.

2. In the first of my experiments on alcohol the introduction of two drams of proof spirits into the stomach of a cat immediately affected the nervous system to such an extent as to cause total insensibility, with laboured and stertorous respiration; nevertheless after the lapse of eight minutes these symptoms began to subside, so that presently the animal was able to stand and walk. In another experiment, in which as much as an ounce and a half of proof spirit had been injected into the stomach of a full-grown rabbit, the insensibility which it occasioned began to subside at the end of forty minutes. It is easy to understand that the effects of the impression made by the poison on the sentient extremities of the nerves, like those of a concussion of the brain, should thus subside, but it does not seem very probable that so large a quantity of spirit should have been absorbed into the circulation and then ejected from it in so short a space of time; nor does this at all correspond with what happens where intoxication is gradually induced in the human subject, and where there can be no doubt as to the alcohol having entered the circulation.

3. That poisons may have a local action on the nerves, so as to affect distant organs, independently of their admission into the blood, is proved by the well known fact to which I have adverted elsewhere, of the pupil of one eye becoming dilated in consequence of the application of the extract of belladonna to the conjunctiva of the same eye, or the neighbouring part of the integuments, while the pupil of the other is wholly unaffected by it.

4. There are numerous examples of mechanical impressions on the sentient extremities of the nerves, the influence of which can be propagated only through the medium of the nerves themselves, affecting the brain so as to occasion a temporary suspension of its functions. Every practical surgeon will recall to his mind numerous instances of a common, simple, and bloodless operation being followed by syncope, and even by stupor, with dilatation of the pupils, and stertorous respiration, and continuing for several minutes, and there is, à priori, no evident reason why the impression made on the nerves by so powerful an agent as the hydrocyanic acid, or the essential oil of bitter almonds, should not do in one case what a slight mechanical injury does in another.

5. In another publication I have referred to another class of cases, the

phenomena of which cannot be well explained except by attributing them to an influence transmitted through the medium of the nerves. Thus, in one instance, acid in the stomach caused a severe pain in the foot, which was immediately relieved by a dose of alkali neutralising the acid. In another instance, a violent pain in the ankle, with inability to move, subsided immediately on the rejection of some indigestible food from the stomach.*

6. I have elsewhere adverted to the analogy which exists between the operation of the nervous power and that of electricity. The influence of volition is transmitted instantaneously from the brain to the muscles, and impressions on the sentient extremities of the nerves are communicated to the brain, the nerves themselves answering the same purpose as the conductors of an electric apparatus. The agent in both instances is invisible, intangible, and known only by the effect which it produces; and, these things being considered, it seems to be not contrary to what analogy would lead us to expect, that in like manner as the electric force, generated by chemical decomposition at one end of a metallic wire, directs the needle of a telegraph, or causes the explosion of gunpowder, at the other extremity, so a substance, such as the hydrocyanic acid, which powerfully affects the vital properties of the part to which it is applied, should be capable, through the medium of the nerves, of disturbing, and even of arresting, the functions of the brain.

I would not, however, be understood as affirming that the facts which I have now stated, or the suggestions which I have offered, are to be regarded as conclusive. Further observations may be required before the question is finally determined. In the meanwhile, in this, as in numerous other instances (which occur not much less frequently in the strict pursuits of science than in the common affairs of life), some individuals will be inclined to one opinion, and others to another, accordingly as one or another order of facts may more especially have engaged their attention.

As connected with this subject I may take the opportunity of noticing a circumstance which came under my observation as long ago as the year 1809, and which seems to show that the influence of certain poisons admits of being propagated to distant parts, by the mere continuity of structures, independently either of the nerves or of the vascular system. A man was admitted into St. George's Hospital who had been bitten by a rattle-snake on the thumb and finger of one hand. The immediate effect of the injury was great constitutional disturbance, from which he gradually recovered. Then the limb became inflamed, and there was sphacelus of the cellular tissue as high as the middle of the arm, followed by suppuration. But, in addition to all this, there were large spots of extravasation of blood in the subcutaneous texture, far beyond the limits to which the inflammation had

* Lectures illustrative of certain Local Nervous Affections, p. 11.

extended. These were observable on the back as low as the hip-joint, and on the anterior part of the chest, over the *pectoralis major* and *serratus anticus* muscles, but they were confined altogether to the side of the body on which the injury had been inflicted, not extending over the median line. The case has been recorded by Sir Everard Home, in the 'Philosophical Transactions' for the year 1810.

Note C. Page 32.

The following observations are extracted from the 27th Volume of the 'Medical and Physical Journal,' in which they were inserted, as I have reason to believe, in consequence of a communication from the late Mr. John Pearson, who, as it appears, had made some experiments, showing the rapidly fatal effects of the poison extracted from bitter almonds, in the year 1806.

'In following Mr. Brodie through his investigations we have been struck with the effect of the essential oil of almonds. The improbability (à priori) of finding such a deleterious substance in that fruit, its instantaneous and vivid effects on the vital principle, not leaving time for absorption, but travelling like the electric fluid along the nerves to the brain, are circumstances not less important than they are astonishing. A gentleman who had the hardihood to apply a particle of the oil to his tongue describes its effect to be like that of a blow on the brain. To the shock succeeded instantaneous mental confusion, and the rapid approach of insensibility. The accuracy of Mr. Brodie both in observation and in detail is remarkably borne out by the coincidence of his experiments with those of Mr. John Pearson, of Golden Square, in 1806.'

In addition to what I have stated elsewhere, it is worthy of notice that the effluvium of the essential oil of bitter almonds partakes of the deleterious quality of the oil itself, as was proved by giddiness and other uncomfortable sensations experienced by myself and some of my pupils, who assisted me in my researches, after we had been for some time exposed to its influence.

I may take this opportunity of observing that the strength of the oil, as a poisonous agent, differs considerably. I suspect that the first portion of the oil, which during distillation passes into the receiver, contains more of the poison than that which is obtained afterwards; and that this explains why the oil which had been prepared as an article of commerce was much less active than that which had been specially prepared for the purpose of my experiments.

Note D. Page 35.

The mode of death in which the cessation of the action of the heart precedes the cessation of that of the muscles of respiration, is not so frequent as that in which the circulation continues after respiration has ceased. I found, however, that some poisoned arrows brought from Mozambique by the late Mr. Salt, produced death in the first of these two ways, thus resembling in their effects the Upas Antiar and the infusion of tobacco; and Dr. Christison has shown that the oxalic acid in a diluted state has, when taken into the stomach, a similar mode of operation.

It is worthy of notice that when death is suddenly produced by exposure to intense cold, the phenomena which occur are very similar to those which follow the exhibition of the above-mentioned poisons. The action of the diaphragm continues after that of the heart has ceased, and the animal dies with scarlet blood, in the left cavities of the heart and in the aorta. This fact has been ascertained by Dr. Chossat and myself, and may be of some practical importance, inasmuch as it has been proved by one of my experiments with the infusion of tobacco, that under these circumstances there is a possibility of the action of the heart being restored, which never can happen when the circulation of dark-coloured blood has continued after respiration has ceased.

In the true *angina pectoris*, depending on ossification of the coronary arteries, it is probable that death takes place in the same way. The supply of scarlet blood to the muscular structure of the heart by these vessels is sufficient for ordinary purposes, but when, under the influence of mental emotion, or from other causes, the heart is required to make any unusual exertion, the supply is insufficient, and its action ceases. Mr. Hunter, however, who laboured under this disease, supposed that on one occasion he kept himself alive by a forced or voluntary act of respiration, after ordinary respiration had been suspended.

The most marked symptom of ordinary syncope is the failure of the pulse, and it is not improbable that in some instances the heart entirely ceases to act, though it resumes its action afterwards.

Note E. Page 41.

Since these experiments were published, I have discovered another effect of the woorara, which illustrates in a striking manner the powerful influence which it exercises over the nervous system, affecting the nerves of motion not less than it does those of sensation. It is well known, that if the spinal chord be divided transversely, although the parts below the

division are deprived of sensibility, nevertheless powerful contractions of the muscles are produced by the mechanical destruction of that portion of the spinal chord from which their nerves are derived. But if an animal be rendered insensible by the woorara, and the circulation be then maintained by artificial respiration, the same effect is not produced by the same injury, the muscles being as wholly unaffected as they would have been in the dead animal.

It has been shown by the Abbé Fontana, that the poison of the viper, virulent as its effects are when applied to a wounded surface, may be taken into the stomach with impunity. A similar observation respecting the woorara has lately been made by M. Bernard and M. Pelouze. The same thing occurs in the case of some animals as to opium. I injected a strong watery solution of opium into the stomach of a rabbit, but no poisonous effect was produced; although a similar solution injected into the cellular membrane occasions stupefaction and death. I presume that the opium is digested by the stomach of the rabbit, although it is not so by that of a carnivorous animal.

Some poisoned arrows from the Andaman Islands, with which I was furnished by the late Mr. Wilkins, were found to act precisely in the same manner as the woorara; and I conclude that all the more concentrated and more powerful narcotic poisons have a like operation, and destroy life by paralysing the muscles of respiration, without immediately affecting the action of the heart. But it is otherwise when, either from the more feeble action of the poison, or from it being more diluted, or more gradually administered, the period of death is protracted. In the case of a patient, who survived the being poisoned by the tincture of opium for more than twenty-four hours, the whole of the vital powers seemed gradually to become exhausted; and from the failure of the pulse, it appeared that the contractions of the heart must have ceased nearly at the same time with those of the muscles of respiration.

The phenomena of death from drowning, strangulation, or confinement in an atmosphere in which there is too large a proportion of carbonic acid, are very similar to those produced by a narcotic poison. The heart continues to act after the animal is apparently dead, and he may be restored to life, if artificial respiration be had recourse to before the circulation has ceased. It is worthy of notice, that under these circumstances the animal does not recover his sensibility, nor his power of locomotion, until some time after he has begun to breathe spontaneously; and hence we may conclude, that the transmission of dark-coloured blood to the brain has not merely a negative but a positive effect—in fact, operating on it in the same way as a narcotic poison. In some instances the affection of the brain thus produced continues so long that ultimate recovery does not take place; the animal (if I may be allowed the expression) dying a second time, in

consequence of the muscles of respiration again ceasing to perform their office. These observations are applicable to the human subject, as well as to the inferior animals.

I have elsewhere * recorded some experiments, showing in what manner death is produced by the discharge of an electric battery. It is not out of place for me to refer to them on this occasion, as the phenomena bore a very near resemblance to those produced by the more powerful narcotic poisons.

Note F. Page 46.

When these observations were communicated to the Royal Society, there was not the same uninterrupted intercourse with other countries as at the present time; and hence it was that I was not acquainted with the very important researches respecting absorption by the veins, an account of which had been previously given to the Institute by M. Magendie. Holding the opinion, which was then universally received, that absorption, in the physiological sense of the word, is performed only by the lymphatic vessels, I was led to believe that as the poison did not enter the circulation by the latter channel, it could have done so only by the wounded veins. With the knowledge of the facts established by M. Magendie, it is scarcely necessary for me to add, that I do not at present doubt that the division of the veins is not necessary to the admission of the poison into these vessels.

Although it is satisfactorily proved that certain poisons affect the system through the medium of the blood, there are nevertheless some facts which seem at first to be incompatible with this view of the subject. I refer more especially to the experiments of M. Magendie, in which he found that when the blood of a poisoned animal had been transfused into the blood-vessels of another animal, the latter was in no degree affected by it. The probable explanation is, that the poisoned blood of the one animal was rendered innocuous by being diluted with the healthy blood of the other.†

In the second volume of the 'Philosophical Transactions' there is the history of an experiment, in which several ounces of the blood of a mangy dog were transfused into the jugular vein of a healthy dog, without the

* Mode in which death is produced by a stroke of lightning—see p. 439, Vol. I. of this edition.

† The same observations may be applied to some experiments recorded by Dr. Addison and Mr. Morgan, in their work on poisons. Indeed it is evident from the way in which these experiments were conducted, that the transfusion must have been very imperfect, and that if any blood actually passed from one animal to the other it could have been only a very small quantity.

latter being affected by the disease. But, on the other hand, I was informed by the late Professor Coleman, of an analogous experiment which he had made, but in a more complete manner, with a different result. Professor Coleman's statement was, that having abstracted so much blood from a sound horse as to induce either complete syncope, or a state approaching to it, he transfused into him the blood of a glandered horse; the result being that the sound horse recovered from the syncope, but some time afterwards was affected by the glanders.

Note G. Page 54.

The cat which was resuscitated, after being apparently dead under the influence of the woorara, was given to a friend, and lived, as I have been informed, for some years.

Not long after this experiment was made, I repeated it on an ass, with the assistance of Professor Sewell, at the Veterinary College. The animal lay in a state of total insensibility (the lungs being inflated by means of a pair of bellows and a tube introduced into the trachea) for more than an hour. He then recovered, and seemed to suffer no inconvenience afterwards. The poison used on this occasion had been given to me by Mr. Waterton, who had himself brought it from America. The ass had been purchased for the purpose of the experiment, by the late Duke of Northumberland (then Earl Percy), and was afterwards given by his Lordship to Mr. Waterton, in whose island he was allowed to range, and where he was alive many years afterwards.

The method of resuscitation, which is here described, is evidently applicable to all cases of apparent death, in which the action of the heart, so as to maintain the circulation, continues after respiration has ceased. The success of the treatment depends, 1st, in cases of poisoning, on the dose of the poison, a limit to the period there being during which life can be maintained by means of artificial respiration; 2ndly, on the inflation of the lungs being carefully made; * 3rdly, on the animal being kept in a temperature of not less than 85 or 90 degrees of heat of Fahrenheit's thermometer. This last precaution is of course a matter of greater importance where the animal is of a small size (as in the case of a cat or rabbit), than where it is larger; still it is not to be neglected even in the case of the human subject; otherwise the animal heat gradually diminishes until it reaches that point at which the action of the heart can no longer be maintained, when we have the singular result of an animal perishing

* On this subject I have offered some observations elsewhere. See Lecture on the effects of Strangulation, p. 420, Vol. I. of this edition.

from cold in the ordinary temperature of the atmosphere. I have not myself known the circulation to continue where the temperature of the interior of the thorax has been below 78° of Fahrenheit; but an experiment is related by Dr. Chossat, in which it had fallen still lower.

It is needless to multiply examples of the kind. I am, however, induced to record the following experiment, as it derives a peculiar interest from the circumstance of the use of ether and other anæsthetic agents having been lately introduced into the practice of surgery.

February 5, 1821.—A guinea-pig was placed under the bell-glass employed in my experiments on animal heat. The bell-glass was left open above, while a small retort containing sulphuric ether was adapted to the tube communicating with the lower part of the apparatus. A lamp was placed below the retort, so as to make the ether boil. The vapour of the ether thus became mixed with the air in the bell-glass, a portion of it becoming condensed on the inner surface of the latter, and on that of the wooden stand on which it was placed.

In two minutes after the experiment was begun the animal moved about briskly, as if affected by the first symptoms of intoxication. In two minutes more he lay on one side in a state of insensibility, but still breathing. He continued in this state, breathing at longer and longer intervals, for six minutes, when respiration had entirely ceased. After two minutes more he was removed from underneath the bell-glass. Though he was apparently dead the heart could be felt beating feebly through the ribs. An opening having been made in the trachea, the lungs were now artificially inflated. Only a few seconds had elapsed before there was a spontaneous effort to breathe, and the pulsations of the heart were more distinct. When the artificial respiration had been kept up for some minutes longer it was discontinued. The animal now breathed naturally, and gave some slight indications of sensibility when touched. This was followed by a tremulous motion of the limbs, and soon afterwards by complete recovery.

Note H. Page 61.

The researches of modern toxicologists, and the application of a more exact chemistry to the detecting of poisons, not only in the alimentary canal, but in the different tissues, and even in the blood itself, afford a sufficient contradiction of the observation, that where death has been produced by arsenic 'but little is to be learned from the examination of the contents of the stomach.' The fact is, that, in pursuing these investigations, the object which I had immediately in view was to determine the operation of poisons

on the various vital organs, and the mode in which they occasion death; and that my attention was only incidentally directed to a subject, which, notwithstanding its great practical importance, is not that which is of the greatest interest to the physiologist.

The world is deeply indebted to those whose successive labours have brought the art of tracing the existence of these mysterious agents after they have done their work of death, to the state of comparative perfection which it has now attained, and especially to M. Orfila, with whom these inquiries may be said to have originated, and who still, after the lapse of forty years, continues to prosecute them with not less zeal than formerly, and with no less success than that which rewarded the efforts of his early life.

ACCOUNT

OF THE

DISSECTION OF A HUMAN FŒTUS,

IN WHICH THE CIRCULATION OF THE BLOOD WAS CARRIED ON WITHOUT A HEART.

From The Philosophical Transactions for 1809.

An opportunity lately occurred to me of examining a human fœtus, in which the heart was wanting, and the circulation of the blood was carried on by the action of the vessels only. There have been some other instances of this remarkable deviation from the natural structure; but in that to which I allude the growth of the child had been natural, and it differed much less from the natural formation than in any of those which are on record, and I have therefore been induced to draw up the following account of it.

A woman was delivered of twins in the beginning of the seventh month of pregnancy. There was a placenta with two umbilical cords, which had their origin about three inches distant from each other. The placenta was not preserved; but Mr. Adams, who attended the mother in her lying-in, observed nothing unusual in its appearance. Both fœtuses were born dead. They were nearly of the same size. One of them in no respect differed from the ordinary formation; the other had an unusual appearance, and Mr. Adams thought it deserving of examination. Through Dr. Hooper it was put into my hands for this purpose.

The fœtus measured thirteen inches from the summit of the cranium to the feet. The thorax and abdomen were surrounded

by a large shapeless mass, which concealed the form of the whole upper part of the body. This mass proved to be the integuments covering the posterior part of the neck and thorax, distended with a watery fluid about three pints in quantity, contained in two cysts, lined by a smooth membrane. When the fluid was evacuated, and the cysts allowed to collapse, the fœtus had nearly the natural form. Its extremities had nearly the usual appearance, except that on the right hand there was no thumb; on the left hand there was no thumb also, and only a single finger. There were three toes on the right foot, and four toes on the left foot. The external nostrils consisted only of two folds of skin, under each of which was the orifice of an internal nostril, but pervious only for about half an inch. There was a hare lip, and a cleft in the bony palate extending one-third of an inch backwards.

On dissection the cranium was found somewhat compressed by the fluid contained in the cyst behind it. The brain itself was too putrid for accurate examination, but it was of nearly the natural size, and nothing unusual was observed in it. The membranes had the natural appearance, and the nerves appeared to go off from the brain and spinal marrow nearly as usual.

In the thorax there was no heart, thymus gland, or pleura. The trachea was situated immediately behind the sternum. It had its natural appearance, and divided as usual into the two bronchia. The latter terminated in the lungs, which consisted of two rounded bodies, not more than one-third of an inch in diameter, having a smooth external surface, and composed internally of a dense cellular substance. The œsophagus had the usual situation, but it terminated in a cul-de-sac at the lower part of the thorax. The rest of the thorax was filled with a dense cellular substance, and in place of the diaphragm, there was a membranous septum between it and the cavity of the abdomen.

In the abdomen, the stomach had no cardiac orifice. The intestine was attached to the mesentery in the usual way, but it was proportionably shorter than natural. There was an imperfect

cæcum, but the colour was not distinguished by any difference of structure or appearance from the rest of the intestine. The rectum had its usual situation in the pelvis. The spleen and renal capsules were small; the kidneys, bladder, penis, and testicles had the usual appearance. The abdomen was lined by peritonæum, but there was no omentum. The liver and gall bladder were wanting.

As there was no heart, it became an object of importance to ascertain the exact nature of the circulation; for this purpose, the blood-vessels were traced with attention.

The umbilical chord consisted of two vessels only; one of these was larger than the other, and its coats resembled those of a vein, while those of the smaller vessel were thick and elastic like those of an artery. Both of these vessels entered the navel of the child. The artery passed to the left groin by the side of the urachus, occupying the usual situation of the left umbilical artery. Here it gave off the external and internal iliac arteries of the left side, and was then continued upwards on the fore part of the spine, forming the aorta. From the aorta rose the common trunk of the right iliac artery, and the branches to the viscera and parietes of the thorax and abdomen. At the upper part of the thorax, it sent off the two subclavian, and afterwards divided into the two carotid arteries, without forming an arch. The veins corresponding to these arteries terminated in the vena cava, which was situated on the anterior part of the spine before the aorta, and passed downwards before the right kidney to the right groin. Here it became reflected upwards by the side of the urachus to the navel, and was continued into the larger vessel, or vein of the chord.

It appears, therefore, that in this fœtus not only the heart was wanting, but there was no communication of any kind between the trunks of the venous and arterial systems, as in the natural fœtus, where there is a heart. The only communication between the two sets of vessels, was by means of the capillary branches anastomosing as usual in the fœtus and in the placenta. The

blood must have been propelled from the placenta to the child through the artery of the chord, and must have been returned to the placenta by means of the vein, so that the placenta must have been at once the source and the termination of the circulation, and the blood must have been propelled by the action of the vessels only.

It is to be understood, that the circulation in the fœtus receives no propelling power from the action of the heart and arteries of the mother. This, although perfectly known to anatomists, it is proper to mention, as it may not be equally known to all the members of this society.

It appears extraordinary, that under these circumstances, notwithstanding the circulation through the placenta must have been more languid than is natural, that organ should nevertheless have been capable of exercising its proper functions, so as to produce those changes on the blood, which are necessary for the maintenance of fœtal life. This may be explained by considering that in the natural fœtus the umbilical arteries are branches of the general arterial system, and only a portion of the blood of the child is sent to the placenta; whereas in the fœtus which I have described, the trunk of the vena cava was continued into the vein of the chord, and the whole of the venous blood circulated through the placenta, and was exposed to the influence of the arterial blood of the mother.

But the most interesting circumstance which we learn from this examination is, that the circulation not only can be carried on without a heart, but that a child so circumstanced can be maintained in its growth, so as to attain the same size as a fœtus which is possessed of that organ. This fact is contrary to what prior experience has led us to expect, as will appear from the following abstract of the authenticated cases of this species of malformation, which we find on record.

A monster in which there was no heart is described by M. Mery.*

* Histoire de l'Académie Royale des Sciences, 1720.

There were twins, one of which was well formed, and of the usual size of a six months child; the size of the other was not mentioned, so that no comparison could be made between them. In the latter, the head, neck, and upper extremities were wanting. There were no vestiges of a brain, nor was there any liver. The dissection of the blood-vessels does not appear to have been very accurately made, but from the general account I should suppose that the circulation did not materially differ from that of the fœtus which I have described.

Another instance of this kind is described by M. Winslow.* This was also a twin only seven inches in length. The age and size of the other child are not mentioned. In this instance there was no head, nor any vestige of a brain. There were no lungs, liver, stomach, nor spleen, and only a small portion of intestine. The arterial system is described as being complete, communicating with the placenta by the umbilical vein opening into the aorta, and the umbilical arteries arising nearly as usual. In this instance there was a circle of vessels formed by the arteries only, for M. Winslow expressly states, that there were no veins; and however extraordinary this may appear, we cannot be otherwise than cautious in denying an observation made by an anatomist so remarkable for his extreme accuracy and minuteness.

Dr. Le Cat of Rouen † states another case of twins, born at the end of the ninth month of pregnancy. One of them was a well-formed child of the usual size; but the other was only twelve inches and a half in length. The head of the latter was very imperfect, and there was only a very minute portion of brain. The heart, lungs, liver, stomach, and spleen were entirely wanting, and there was only a small portion of intestine. The arterial system was perfect; the umbilical vein terminated in the aorta, and the umbilical arteries had their origin from the internal iliac, as usual. There is, however, an obscurity in the account of the circulation, as it is stated that there were veins, but they were not

* Histoire de l'Académie Royale des Sciences, 1740.

† Philosophical Transactions for 1767.

traced, nor was any communication made out between them and the arteries, or the vessels of the chord.

Dr. Clarke * has given an account of a case, in which a woman, after a natural labour, was delivered of a healthy child, and also of a substance covered by common integuments, of an oval form, four inches in length, and having a separate navel string and placenta. In this substance there was one os innominatum, with a femur, tibia, and fibula. There were neither brain nor nerves; nor were there any viscera, except a small portion of intestine. The umbilical chord consisted of two vessels, an artery and a vein, both of which ramified in this substance and in the placenta.

In Dr. Hunter's anatomical collection there are two specimens of monsters born without hearts. In both of them the whole upper part of the body was wanting; and in neither was the exact nature of the circulation ascertained.

In each of the instances which I have quoted, not only the heart was wanting, but the fœtus in other respects was so imperfect, that it could not be considered as anything more than a mola, or an irregularly formed living mass connected with the placenta. In particular, in all of them the brain, which with justice may be considered as affording the best distinction between a mola and a fœtus, was wanting; whereas in that which forms the subject of the present paper, the brain was nearly as large as usual, and in other respects the fœtus varied much less from the natural structure than in any former instance.

In the cases already on record, we have seen, that wherever the size of the monster was mentioned, it was much smaller than a natural fœtus. This would have led to the supposition, that a circulation, which was carried on by the action of the vessels only, was incapable of maintaining the natural growth of a child, had it not been found that the fœtus, which I have described, though the heart was wanting, was fully equal in size to a fœtus of the same age, which was possessed of that organ.

* Philosophical Transactions for 1793.

It may be observed that in all these cases in which the heart was wanting, the liver was wanting also. It is probable that the action of the vessels only without the assistance of the heart would have been insufficient to propel the blood through the circulation of the liver, which is so extensive in the natural fœtus.

ON THE

INFLUENCE OF THE NERVOUS SYSTEM

ON THE ACTION OF THE MUSCLES IN GENERAL AND OF THE HEART IN PARTICULAR.

The Croonian Lecture for 1813.

Read at the Royal Society, November 11th, 1813.*

I.

In all animals except those of the very lowest class, a distinct nervous and muscular system are found combined in the same individual, and the functions of the one are very much connected with, and influenced by, those of the other. If the nervous system is in a state of excitement, the contractions of the muscles are rendered more powerful and more frequent; and if its functions are impaired, muscular paralysis is the consequence. These circumstances have induced some physiologists to consider the contractile power of the muscles as wholly dependent on the nervous influence.

Baron Haller appears to have been the first who took a very scientific view of this subject. He distinguished between the irritability of a muscle, or its capability of contracting, and the immediate cause of stimulus by which the contraction is produced. His experiments led him to conclude that the former may exist independently of anything derived from the nerves; that impressions communicated by the nerves form one class of stimuli,

* This communication was ordered by the Council to be printed, but the printing was postponed at the request of the author. The Council have permitted me to copy it from the Archives of the Society.—C. H.

but that impressions of other kinds may operate as stimuli also. Thus the voluntary muscles were considered as subjected to the nerves, in so far as they receive through them the stimulus of volition, while the heart is excited to action by the contact of the blood, and is altogether independent of the nervous influence. The doctrine of Haller appeared to derive ample confirmation from the experiments of Cruikshank,* Bichât,† and myself,‡ which proved that the functions of the brain may be completely destroyed without any interruption to the circulation of the blood.

The very curious and original investigations of M. Le Gallois (an account of which was published in Paris in the year 1812) have tended to throw a new light on this subject. The experiments of this physiologist have led him to the following conclusions:

1. That the spinal marrow is the seat of sensation and volition, and that the nervous influence, whatever it may be, is generated in it, as well as in the brain.§

2. That the spinal marrow furnishes to the whole of the system the principle of life, so that if a portion of it be destroyed, the death of those parts which derive their nerves from it is the consequence.‖

3. That the stimulus of the blood is the immediate cause of the contraction of the heart; but that this organ, like the other muscles, derives its vitality, and its capability of contraction, from the spinal marrow, so that if the whole, or even a considerable portion of the latter be destroyed, the circulation of the blood ceases.¶

* Philosophical Transactions, 1795.

† Recherches Physiologiques sur la Vie et la Mort.

‡ 'Croonian Lecture,' 'Philosophical Transactions,' 1811.

§ Expériences sur le Principe de la Vie, notamment sur celui des Mouvements du Cœur et sur le Siége de ce Principe. Par M. Le Gallois, Paris, 1812, p. 138, et passim.

‖ Op. cit. p. 140, et passim. M. Le Gallois does not express himself clearly on this point. It would seem, from some of his observations, that he considers the destruction of a portion of the spinal marrow not only as affecting the contractility of the muscles, but as causing the capillary circulation to stop in those parts which receive their nerves from it.

¶ Op. cit. p. 159.

The facts from which these conclusions were drawn must be allowed to be novel and highly interesting; but the subject still seems to demand further investigation. I have repeated the greater number of M. Le Gallois's experiments: from these I have been led to institute others, and in the present Croonian Lecture I have the honour of laying the result of my inquiries before the Royal Society.

II.

I found the effect produced on the heart's action by the destruction of the spinal marrow to be precisely such as has been stated by M. Le Gallois. The circulation ceases either instantaneously, or after a very short period of time; but in order that the fact should be satisfactorily explained, it appeared to be desirable, that more accurate observations should be made on the effects which the destruction of the spinal marrow produces on the vitality of other parts of the body, and on the contractile power of other muscles.

The blood passing from the arteries into the veins of the greater circulation, undergoes a change in its properties, which is marked by an alteration in its appearance from a scarlet to a dark colour. Whatever may be necessary besides, this change of the blood in the capillary vessels is essential to life generally, and to the maintenance of the particular functions of every organ, which enters into the composition of the animal system. Various circumstances render it very improbable that the influence of the spinal marrow should be necessary to the production of this in the circulating blood, and the following experiment seems to remove any doubt which might exist on this subject.

Exp. 1. A dog was killed by the division of the spinal marrow in the upper part of the neck, and immediately afterwards the posterior extremities, with the pelvis and lumbar vertebræ, were separated from the rest of the body. The termination of the spinal marrow in the cauda equina was completely destroyed by means of a rod of iron introduced into the theca vertebralis. A

metallic tube having been introduced into the aorta immediately above its bifurcation, blood of a bright scarlet colour from the carotid artery of a horse was injected into the arteries of the hind limbs by means of a syringe. The injected blood returned of a dark colour. The experiment was continued during a period of more than ten minutes, and the blood always flowed from the orifices of the divided veins of a dark colour, except when much force was used in making the injection, and then the alteration in the colour of the blood was always less in proportion as the velocity was greater.

If a nerve be divided, the parts to which it is distributed retain their vitality, and the muscles, though no longer subjected to volition, are still capable of being excited by means of other stimuli; but this does not in itself prove the influence of the spinal marrow to be unnecessary to life, since the small nerves everywhere, but particularly those of the skin, extensively unite with one another, so as to maintain an indirect communication with the spinal marrow, by means of which the influence of the latter may be supposed to be kept up, in like manner as the circulation of the blood in a limb continues by means of the anastomosing vessels after the principal artery is obliterated.

The following experiments were instituted for the purpose of ascertaining the effects which are produced where the influence of the spinal marrow on a part of the animal system is more completely destroyed.

Exp. 2. The theca vertebralis of a frog having been exposed near the pelvis, the texture of the posterior part of the spinal marrow, where the nerves of the posterior extremities arise from it, was destroyed by means of a wire. The immediate consequence of this was the complete paralysis of the hind limbs. Two days afterwards the webs of the hind feet having been examined in a microscope, the circulation of the blood in the capillary vessels was found as active as under ordinary circumstances. The muscles of the thighs and legs were made readily to contract by means of the voltaic battery; and when a battery consisting of

several pairs of plates was employed, the contractions were not less powerful than those which take place in voluntary movements.

Exp. 3. In another frog, four days after the destruction of the posterior part of the spinal marrow, on examining the webs of the hind feet in the microscope, the capillary circulation was found to be not at all different from what it is under ordinary circumstances, and the muscles of the hind limbs were made to contract readily and powerfully by means of the voltaic battery.

Exp. 4. In a dog I divided the skin and muscles, which lie before the axillary plexus of nerves, and afterwards the nerves themselves. I then divided the remaining skin and muscles, the cellular membrane in the axilla, and every other part by which the scapula and anterior extremity are attached to the trunk, with the exception of the axillary artery and vein, so that these vessels were completely insulated, and formed the only connection between the limb and the rest of the animal. The divided edges of the skin were brought together by means of sutures. The circulation continued in the limb, and the pulse of the radial artery was distinctly to be felt a little above the wrist. Twenty hours afterwards, an incision having been made in the fore-arm, the arteries bled freely, the blood being of a scarlet colour. The muscles were made to contract powerfully by means of the voltaic battery, and when several pairs of plates were employed the contractions did not seem to be less powerful than those which arise from the stimulus of volition. On the following day the dog died. The limb was examined very carefully, and not the smallest connection was found remaining between it and the trunk, except that by means of the axillary artery and vein.

These experiments show that the vitality of a part may continue, and that the muscles may retain their contractile power, although completely deprived of the influence of the brain and spinal marrow; and they afford a more ample confirmation of the Hallerian doctrine of muscular irritability, than any which (as far as I know) have been before published.

Do the nerves possess the property of generating the nervous

influence as well as the spinal marrow itself? and may the former be supposed to conduce to the maintenance of the nervous influence after all communication with the latter is destroyed? This might constitute another subject of inquiry, concerning which I shall only observe that it does not seem to admit of being either absolutely confirmed, or absolutely refuted, by direct experiment; but that many circumstances tend to prove that, in the higher orders of animals, the nerves simply act as conductors between their sentient extremities, and the brain or spinal marrow in which they have their origin, and there seems to be no fact to warrant us in believing that they answer any other purpose.

A regular and constant supply of blood, which has been exposed to the influence of the air, appears to be the most essential circumstance towards the maintenance of life in the whole or in any part of the animal system. M. Bichât has shown that when the supply of arterial blood to the brain is interrupted, the functions of that organ are annihilated, and various facts, which it would be unnecessary to enumerate, lead to the same conclusion with respect to the muscles. The principle of vitality is imparted by the same means to different organs, and to them, according to their difference of structure, it shows itself in various ways and produces various phenomena.

III.

When the spinal marrow of a warm-blooded animal is destroyed, the circulation of the blood ceases after a period of time, which varies from one to five or six minutes, according to the age of the animal, and as the whole or part of the spinal marrow is made the subject of experiment: nor can the circulation be maintained by means of artificial respiration, as after decapitation. The fibres of the heart, indeed, continue to contract for some time afterwards, particularly if it be exposed to the action of the air, or excited by a mechanical stimulus; but these contractions may be readily distinguished from those which take place in the living animal. The muscular coats of the heart, instead of being firm and unyielding, are soft and flaccid to the touch, and the contractions are feeble and irregular, and no more fitted to maintain the circulation

than the tremulous action of the muscles of the extremities which remain after death is to produce the locomotion of the animal.

One method of accounting for the effect on the circulation produced by the destruction of the spinal marrow, is to suppose that the heart derives from it its principle of irritability, by which it is rendered capable of contracting on the application of a stimulus. But it has been shown that the nervous influence is not necessary to the irritability of the other parts of the muscular system; and as it is highly improbable that the source of irritability in one muscle should be different from that in another, some other explanation of the connection between the spinal marrow and the heart appears to be required.

From having adopted the theory of Haller that the blood forms the stimulus to the heart, by which the successive contractions of its different cavities are produced so as to maintain the circulation, I had been led to imagine that, if an animal which died of hæmorrhage were immediately examined, the heart must be found to have ceased acting in consequence of its natural stimulus being wanting, and it was with some degree of surprise that I learned from the following experiments (which were instituted with a view to another investigation) that the fact is otherwise.

Exp. 5. In a rabbit nearly full grown, I divided in one incision both carotid arteries near their origin, and the other vessels in the lower part of the neck. There was a profuse hæmorrhage, and in thirty seconds all appearance of sensibility and voluntary motion had ceased. Two minutes after the division of the blood-vessels I opened into the chest, and found the heart acting 140 times in a minute. The contractions bore no resemblance to those which are kept up after death by the contact of the air; they were regular and vigorous; the muscular parietes were firm and unyielding to the touch; nor did the appearance of the heart at all differ from that in the living animal, except that it was of a smaller size, in consequence of its cavities not being distended with blood. An incision having been made into the right ventricle, a very minute quantity of blood oozed from it, but the left ventricle was entirely empty.

Exp. 6. A rabbit was inoculated with woorara poison, and, when apparently dead, the circulation was kept up by means of artificial respiration. The thorax having been opened into the heart was found acting 140 times in a minute. I made an opening into the aorta and vena cava inferior at a little distance from the heart. There was a profuse hæmorrhage, and the heart almost immediately became empty of blood, but this seemed to produce no difference in its action. At the end of two minutes the contractions were still equally regular, frequent, and vigorous, as in the living animal; from this time they became less frequent, feeble, and irregular.

In these experiments, the action of the heart, instead of being stopped, continued apparently unaltered for at least two minutes after that viscus and the great blood-vessels were empty of blood; and this cannot be explained on the supposition that the contractions of the heart are produced by the stimulus of the blood applied to its different cavities, since we find on other occasions that the contractions of a muscle cease immediately on the stimulus which produced them being removed.

It is well known that in an animal which is suffocated, the heart continues to contract for a short time after respiration has ceased, circulating dark-coloured blood, and hence I was led to institute the following experiment, with a view to the further elucidation of this subject.

Exp. 7. I procured two young rabbits of the same age and size. A ligature was tied round the neck of one of them so as to strangle it. At the end of one minute all appearance of sensibility and voluntary motion had ceased. At the end of three minutes and a half I opened into the chest, and found the heart distended with dark-coloured blood. There were some feeble and irregular contractions of the ventricles, but not sufficient to maintain the circulation, as on dividing the subclavian arteries not a drop of blood flowed.

In the other rabbit the carotid and subclavian arteries and the accompanying veins were divided at one incision. There was a

profuse hæmorrhage, and at the end of thirty seconds there were no remains of sensibility and voluntary motion. At the end of three minutes and a half, the chest having been opened into, the heart was found acting 120 times in a minute, and the contractions were equally regular, and nearly as vigorous and powerful as in the living animal, and much more so than they were at the same period in the rabbit which had been strangled. On cutting into the left ventricle it was found to be nearly empty; a very small quantity of blood oozed from the right.

In this experiment the action of the heart continued longer in the animal which died of hæmorrhage than in that which was killed by suffocation, and this confirms the conclusion that it is not from the stimulus of the blood applied to its different cavities, but from a stimulus of another kind, that the contractions of the heart are produced, so as to maintain the circulation in the living animal.

Indeed, if we examine the commonly received doctrine on this subject, it will appear that, in many respects, it does not afford a very satisfactory explanation of the phenomena of the circulation.

1. If a person loses a considerable quantity of blood, the contractions of the heart are rendered more frequent, as if to make up by the more rapid circulation for the diminished quantity of the circulating fluid. Were the blood the stimulus which excites the heart to contract, the loss of blood ought to diminish the frequency of its contractions, since a longer time would be necessary for a sufficient quantity of the stimulus to be accumulated in any one of its cavities.

2. As the valves of the heart open in the direction of the circulation, the auricle and ventricle of each side, with respect to the blood entering the heart, may be considered as forming a single cavity, of which, if the blood were the stimulus producing the contraction, the whole should dilate and contract at the same instant, instead of the two portions dilating and contracting in succession, as we find to be the case.

3. The sudden changes in the state of the pulse, which are

produced by certain affections of the mind, by disease, and by some other causes, scarcely admit of being reasonably explained on the supposition of the circulation being kept up by the stimulus which the blood affords to the fibres of the heart.

IV.

The spinal marrow may be supposed to be necessary to the heart's action by supplying to that organ its principle of irritability by which it is rendered capable of contracting on the application of a stimulus; but circumstances, which it would be needless to recapitulate, seem fully to contradict this hypothesis.

The spinal marrow may also be regarded as furnishing the stimuli which operate as the immediate cause of the heart's contractions, in like manner as certain impressions, conveyed along the nerves from the brain, produce and maintain the contractions of the diaphragm; and many arguments may be adduced to prove that this is the just explanation of the effect which the destruction of the spinal marrow produces on the circulation.

1. If the generation of muscular irritability be independent of the nervous influence, it is difficult to conceive in what other way the spinal marrow can be necessary to the action of the heart, except by transmitting the stimuli or impressions, on which its action immediately depends.

2. Muscular contraction may always be referred to a stimulus as the immediate exciting cause; and if the blood is not the stimulus by which the natural action of the heart is produced, there seems to be no source from whence the stimulus can be derived, except it be from the nervous system.

3. A variety of phenomena in the living animal demonstrate the powerful influence of the nervous system on the heart's action. Certain passions or emotions of the mind, existing in a moderate degree, render the contractions more frequent: the same passions existing in a greater degree produce an opposite effect, and occasion syncope. The state of the pulse indicates not only the state of the muscular, but that of the nervous, system also.

4. Independently of the circulation of the blood and of voluntary movements, muscular action is concerned in many other animal functions, and it may be always traced to impressions communicated from the nervous system as the immediate exciting cause.

(1.) Respiration is produced by the never-ceasing action of the diaphragm, as the circulation is by that of the heart, and there can be no doubt that the diaphragm is stimulated to contract by impressions which it is constantly receiving through the medium of the phrenic nerves.

(2.) The uterus in parturition is excited to contract, not by the stimulus of its contents, but by the influence of the nervous system; which is proved by this circumstance, that, in a case of extra-uterine conception, when the uterus contains only the membrana decidua, it begins to contract at the same period of time, as in common pregnancy when it contains the fœtus and other membranes.

(3.) Vomiting is produced by tickling the fauces, by various affections of the brain, and by injuries of the nerves of the eighth pair; and the experiments of M. Magendie prove that an emetic operates not by the stimulus which it affords to the coats of the stomach, but by inducing a particular state of the nervous system, in consequence of which there is a sudden and violent contraction of the diaphragm and abdominal muscles.

(4.) In sneezing, coughing, laughing, and on a variety of other occasions, the successive contractions of the different muscles which are concerned in these actions may be traced to a similar source.

From these analogies, and from all the circumstances which have been stated, we are warranted in drawing the conclusion that the heart is stimulated to contract, not by the blood in its cavities, but by certain impressions which are communicated to it through the medium of the nerves; and that those impressions are derived originally not from the brain, but from the spinal marrow, is proved by this, that when the latter is destroyed, the circulation immediately ceases, while decapitation may be performed without the circulation being in the smallest degree affected.

V.

If in a full-grown warm-blooded animal the texture of the whole spinal marrow is suddenly destroyed, the circulation stops almost instantaneously; but if the experiment is made on a young animal, a space of time varying from one to two or three minutes generally elapses before the effect is produced.

I have made a similar observation with respect to respiration. If in a full-grown animal the lower part of the medulla oblongata is transversely divided, the contractions of the diaphragm cease from this instant; but in a young animal they continue for one, two, or three minutes afterwards; and in animals of the same age, the period during which respiration continues after the division of the medulla oblongata, is nearly the same as that during which the blood continues to be circulated after the destruction of the spinal marrow.

It has been shown by M. Le Gallois that the part of the brain which is immediately concerned in producing respiration is that portion of the medulla oblongata which gives origin to the nerves of the eighth pair. The phrenic nerves which form the communication with the diaphragm arise considerably lower down, and when the inspirations continue after the division of the medulla oblongata in the upper part of the neck, we must suppose that a sufficient quantity of the nervous influence remains in the spinal marrow immediately below, to stimulate the diaphragm to contract for a short period of time.

The nerves from the spinal marrow are sent not to the heart itself, but to the ganglions of the great sympathetic nerve; from thence filaments proceed to form the cardiac plexus, and from the last the heart is immediately supplied.

When in a young animal the destruction of the spinal marrow is not attended with an instantaneous stoppage of the circulation, we may suppose that the ganglions of the great sympathetic nerve, or the cardiac plexus, or both, retain a sufficient quantity of the nervous influence to stimulate the heart to contract for the short period of time during which the circulation continues.

If the spinal marrow is destroyed in a frog, the contractions of the heart instantly become very feeble, and much diminished with respect to frequency; but nevertheless they continue so as to maintain a languid circulation in those parts which are in the immediate neighbourhood of this organ for some hours afterwards. It would appear that in this animal the system of the great sympathetic nerves is capable of retaining some degree of nervous influence for a longer period of time, after the destruction of the spinal marrow, than in animals of the warm-blooded class. This is conformable to what we might be led to expect from the following circumstances. If the brain of a warm-blooded animal be destroyed, and the circulation of the blood is maintained by means of artificial respiration, the spinal marrow retains its sensibility, and in some degree the faculty of volition, generally only for a few minutes, at any rate for not more than one or two hours afterwards, although life and the action of the voluntary muscles continue during a much longer period; but in a frog sensibility, and a kind of imperfect volition, may linger in the spinal marrow for two or three days after decapitation.

I am not acquainted with the effects produced by the destruction of the spinal marrow in any cold-blooded animal besides the frog; but it is probable that if the investigation were pursued in other reptiles, and in the lower order of animals, in which the nervous system assumes a more simple form, we might arrive at some interesting results. The subject is by no means exhausted, but the facts which have been already established seem to be alone sufficient to lead to some new and not unimportant views, both in Physiological and Pathological science.

EXPERIMENTS AND OBSERVATIONS

ON THE INFLUENCE OF

THE NERVES OF THE EIGHTH PAIR

ON THE SECRETIONS OF THE STOMACH.

From The Philosophical Transactions for 1814.

In a paper formerly communicated to this Society by Sir Everard Home, and since published in the 'Philosophical Transactions' for the year 1809, some facts were stated which render it probable that the various animal secretions are dependent on the influence of the nervous system, and this opinion seemed to derive support from some physiological experiments which were afterwards instituted by myself, and in which it was observed, that after the functions of the brain had been destroyed, although the action of the heart continued, and the circulation of the blood was maintained as under ordinary circumstances, the secreting organs invariably ceased to perform their office.

It has been attempted by former physiologists to determine how far the nerves are necessary to secretion, but there are considerable obstacles in the way of this inquiry, and no observations that have been hitherto made appear to throw a great deal of light on the subject. The only method which can be devised of ascertaining by direct experiment whether the nerves are really necessary to secretion, is that of dividing the nervous branches by which the glands are supplied. But this, with respect to the greater number of the glands, is an experiment impossible to perform; and, with respect to others, cannot be executed without so much disturbance

and injury to the other parts, as must render it extremely difficult to arrive at any positive results. Perhaps in future investigations some circumstances may arise, which will enable us to determine more satisfactorily this important physiological question. In the meantime, as the labours of physiologists have hitherto contributed so little to this purpose, any facts which tend to its elucidation may deserve to be recorded, and I am therefore induced to lay before the society the following experiments, which afford one example of a secretion being dependent on the influence of the nerves.

The stomach derives its nerves principally from those of the eighth pair, or the par vagum; and the same nerves, as they assist in the formation of the semilunar ganglions, contribute to the supply of the rest of the alimentary canal, particularly of the small intestines. In an inquiry which I had formerly instituted respecting the functions of the stomach, I divided these nerves in the neck of a dog, for the purpose of ascertaining the influence which they possess on the secretion of the gastric juice; but I was disappointed in my expectation, since the animals always died, in consequence of the disturbed state of the respiration which the injury of the nerves occasioned, before there was an opportunity of ascertaining the effect produced on the process of digestion.

I had formerly ascertained, that in a dog poisoned by arsenic there is a copious secretion of mucus and watery fluid from the mucous membrane of the stomach and intestines, which are in consequence found after death completely and preternaturally distended: and it occurred to me that, although I could not ascertain the effect of the division of the nerves of the eighth pair on the natural secretions of the stomach, it might be possible to ascertain the effect on a secretion thus artificially produced. With this view I instituted the following experiments:—

Exp. 1. The nerves of the eighth pair, with the accompanying sympathetic nerves, were divided in the neck of a dog, and immediately afterwards ten grains of arsenic were inserted into a wound in the thigh. The breathing became laborious, as is usual

when these nerves are divided, and afterwards the same symptoms took place, as commonly arise from the poison of arsenic, with this difference, that there was no discharge of fluid either from the stomach or intestines. He died at the end of three hours and a half. On dissection, the stomach and intestines were found to contain only food and fæces, there being none of the mucous and watery secretion usually met with in an animal which has been killed in the same manner. The mucous membrane of the stomach and intestines was highly inflamed.

Exp. 2. The experiment was repeated on another dog. He died at the end of nine hours, and on dissection the stomach and intestines were not found to contain any mucous or watery fluid. Their mucous membrane was inflamed.

Exp. 3. A dog, immediately after the division of the same nerves in the neck, was made to swallow two ounces of saturated solution of white oxyde of arsenic in water. He died at the expiration of three hours; on dissection, the stomach and intestines were found slightly inflamed, and they contained no mucous or watery fluid.

In these experiments, the animals died from the application of the arsenic, and the poison produced the usual symptoms, with the exception of the copious mucous secretion, which takes place in other instances, from the stomach and intestines. The obvious conclusion was, that this secretion was prevented in consequence of the nervous influence having been interrupted by the division of the nerves of the eighth pair; but as this injury always induces a disturbed and laborious respiration, it was desirable to ascertain how far this circumstance must have operated towards the production of this effect, and I therefore repeated the experiment, but with this difference, that the nerves were divided in such a way as not to interfere with the functions of the lungs.

Exp. 4. Having made an incision into the abdomen of a dog, immediately below the short ribs, I divided, by means of a bistoury, the stomachic ropes formed by the nerves of the eighth pair, where they are situated on the œsophagus, immediately above

the cardiac orifice of the stomach. The wound was closed by sutures. The respiration was not in the least disturbed, but was performed as frequently, and with as much ease, as under ordinary circumstances. The animal was afterwards inoculated in the thigh with the white oxyde of arsenic, and he died in a few hours after the application of the poison, with the ordinary symptoms, except that there were no fluid evacuations from the stomach or intestines.

On dissection, the mucous membrane of the stomach and intestines was found inflamed. There was no watery or mucous fluid in the stomach or small intestines. There was a small quantity of mucus in the colon.

The result of this being the same as that of the former experiments, we may conclude that the suppression of the secretions in all of them was to be attributed solely to the division of the nerves: and all the facts which have been stated, sufficiently demonstrate that the secretions of the stomach and intestines are very much under the control of the nervous system. We cannot indeed venture to deduce from them any positive conclusions respecting the necessity of the nervous influence to the secretions in general, but as forming one link in the chain of an interesting but difficult physiological investigation, the circumstances which have been mentioned may perhaps be considered as possessing some value and as worthy of being recorded.

It is proper to observe, that I have attempted to pursue the investigation, so as to ascertain the effect produced on the process of digestion by the division of the stomachic ropes on the termination of the œsophagus, but various circumstances, which it would be unnecessary to enumerate, have prevented my proceeding in the inquiry, and seem almost to render it impossible to make any observations on this subject.

PATHOLOGICAL AND SURGICAL OBSERVATIONS ON THE DISEASES OF THE JOINTS.*

The fifth edition of my Treatise on the Diseases of the Joints, which is now offered to the public, differs, in many respects, from those by which it has been preceded. I have found no reason to alter the general arrangement of these diseases which my early investigations had led me to adopt. But many new cases and observations have been introduced, illustrating the pathological changes which were described formerly; and some new chapters have been added, relating to other changes, which my earlier experience had led me to notice only in a brief and cursory manner. Those parts which relate to the diagnosis and treatment of diseases have been considerably extended; and I hope that the volume will thus be rendered more useful to the practical surgeon,

* These observations were commenced in papers read before the Royal Medical and Chirurgical Society, and published in Volumes IV., V., and VI. of the Medico-Chirurgical Transactions. The first paper was communicated to the Society by Dr. Roget, in April 1813; these were first published in a separate form in 1818, other editions followed in 1822, 1834, 1836, 1850.

There is one subject not treated of by the author, that has created much interest in the profession of late days, that of the re-section of joints in the place of amputation. Sir Benjamin Brodie some years ago removed the head of the femur from a patient in St. George's Hospital. But his teaching and practice for many years was so to treat diseases of the joints as to render operations as much as possible unnecessary.

Further observations by the author, on which he was engaged at the commencement of his last illness, will be found in Vol. III.—C. H.

whose principal object must always be to obtain the means of cure, and to whom scientific pathology will be valuable in proportion as it leads to this ulterior result.

Although these researches have occupied more or less of my time during the greater part of my professional life, I am aware that they are still imperfect. When I first turned my attention to the subject, I found that I was engaged in a new and extensive field of inquiry, such as it was impossible for one individual however diligent, and however great his opportunities, thoroughly to explore. Those who follow me will, I doubt not, find much both to add and to correct; but I trust that what I have been able to accomplish will assist them in their labours, and will, in the meanwhile, in some degree, supply what was formerly a great deficiency in the literature of scientific surgery.

In the earlier editions I published a series of cases illustrative of the history and progress of the various diseases of the joints, as they are exhibited in the living person, and the treatment which they require. I was led to do so, as the subject was at that time, in a great degree, new to my readers, as it had been to myself. Under present circumstances it has appeared to me that another course was to be preferred, and I have accordingly endeavoured to supply the information which it was thus intended to convey in the form of a more complete analysis of the observations which I have made in the course of my practice, omitting the details of individual cases, with the exception of those relating to pathology.

B. C. B. 1850.

OBSERVATIONS

ON THE

DISEASES OF THE JOINTS.

INTRODUCTION.

THE following pages contain a series of observations which were begun many years ago, and which have been continued, not without considerable labour, up to the present period. They relate to a class of diseases which have strong claims on the attention of the surgeon, since they are of very frequent occurrence, are a source of serious anxiety to the patients, and, for the most part, if neglected, proceed to an unfavourable termination. There are other circumstances also which seem to render the morbid affection of the joints a fit subject of investigation. They have scarcely met with the attention which they merit from former pathologists. The terms, white swellings, scrofulous joints, &c., have been used without any well-defined meaning, and almost indiscriminately; so that the same name has been frequently applied to different diseases, and the same disease has been distinguished by different appellations. Confusion with respect to diagnosis always gives rise to a corresponding confusion with respect to the employment of remedies; and hence I was induced to hope, that, if it were possible to improve our pathological knowledge of the diseases to which I have alluded, this might lead, not indeed to the discovery of new methods of treatment, but to a more judicious and scientific application of those which are already known, and a consequent improvement of chirurgical practice.

The joints, like the other animal organs, are not of a simple

and uniform, but of a various and complicated, structure. Although, in their advanced stages, the diseases to which they are liable extend to all the dissimilar parts of which they are composed, it is to be presumed that such is not the case in the beginning. We cannot doubt that here, as elsewhere, the morbid actions commence sometimes in one, and sometimes in another, texture; and that they differ in their nature, and are variously modified, and of course, require to be differently treated, according to the mechanical organisation, and the vital properties of the part, in which they originate.

It was under the influence of these impressions that I endeavoured to pursue my inquiries into the subject of the present treatise. Believing that nothing has contributed in a greater degree towards the modern improvements in surgery, than the practice of investigating by dissection the changes of anatomical structure which disease produces, I availed myself of every opportunity which occurred of making such examinations. In particular, I was anxious to do this where the morbid changes were still in an early stage, and where I had the opportunity of noting the symptoms by which the incipient disease was indicated; and the knowledge which was thus acquired became the basis of my subsequent observations. In laying the results before the public, I cannot be otherwise than conscious, that these researches are still imperfect. But I feel assured, at the same time, that those who are engaged in the study of pathology, will make due allowance for the difficulties which belong to this most complicated of all the sciences, and will not be disposed to criticise my labours severely, because they find that there is still an ample space left for those who may be willing to engage in similar inquiries.

My earliest observations on the subject of these diseases, were recorded in three papers published in the fourth and two subsequent volumes of the Transactions of the Royal Medical and Chirurgical Society. In the course of the time which has since elapsed, a large surgical practice has enabled me to obtain a more accurate knowledge of their history than I then possessed, and has,

at the same time, led me to the employment of more simple and successful methods of treatment. I have, however, met with no reason for making any essential change in the classification of those affections of the joints which are of most frequent occurrence. Indeed, it has been to me a source of much satisfaction, that all my subsequent experience has tended to confirm the general accuracy of those pathological views which I was led to adopt formerly, and which I ventured to bring forward in the first of those papers to which I have alluded.

CHAPTER I.

INFLAMMATION OF THE SYNOVIAL MEMBRANES OF JOINTS.

Section I.

Pathological Observations.

The soft parts, which, added to the bones and cartilages constitute the structure of the joints, are: the synovial membranes, by which the lubricating fluid is secreted; the ligaments, by which the bones are connected to each other; and the fatty substance, which occupies what in certain positions would otherwise be empty spaces. It is to be supposed, that the adipose membrane belonging to the joints may be inflamed; that it may be the seat of abscesses and tumours, as well as that which is situated beneath the skin or in the interstices of the muscles; and the ligaments cannot be regarded as more exempt from disease than the fibrous membranes, which they very nearly resemble in their texture. It is not improbable that some of the pains which take place in the joints in rheumatic and syphilitic affections, may depend on a diseased action occurring in the ligaments; and there can be no doubt that the long-continued symptoms, which occasionally follow a severe sprain, depend on these same parts being in a state of slow inflammation, in consequence of some of their fibres having been ruptured or over-stretched. I cannot say that I have never seen a case where disease, independently of these causes, has originated in the ligaments; but I certainly have never met with a case where it has been proved to have done so by dissection; and it may be safely asserted, that this is a rare occurrence, and not what happens in the ordinary diseases to which the joints are liable.

On the other hand, no part of the body is much more frequently diseased than the synovial membranes. This is what their anatomical structure and functions might lead us to expect, since we find that living organs are more subject to have their natural functions deranged, in proportion as they are more vascular, and as they are employed in a greater degree in the process of secretion.

The synovial membranes of the joints were not very clearly described by the older anatomists. A sufficiently accurate account of them, however, was published by Dr. William Hunter, in a communication to the Royal Society on the structure of cartilage, published in the forty-second volume of the Philosophical Transactions, and since then they have been described with great accuracy by M. Bichat, in his *Traité des Membranes*; and to these authors I may refer those of my readers who wish to see their anatomy more fully explained. At present it is sufficient for me to observe, that the office of the synovial membrane of a joint is to secrete the synovia, by which the joint is lubricated; that it lines the ligaments, by which the bones are held together; covers the bones themselves for a small extent, taking the place of the periosteum; and that from thence it passes over the cartilaginous surfaces, and the inter-articular fat. Where it adheres to the bones and soft parts, it very much resembles the peritonæum in its structure, and possesses considerable vascularity; but where it is reflected over the cartilages it is thin, and readily torn: its existence, however, even here, may be always distinctly demonstrated by a careful dissection. The synovial membrane of a joint forms a bag, having no external opening; in this respect resembling the peritonæum, the pleura, and the pericardium; which it also resembles in its functions, and to which it bears some analogy in its diseases.

Cases occasionally (but not often) occur, in which a joint is swollen from a preternatural quantity of fluid collected in its cavity, without pain or inflammation. This may be supposed to arise, either from a diminished action of the absorbents, or an

increased action of the secreting vessels. The disease may be compared to the dropsy of the peritonæum or pleura; or more properly, to the hydrocele; and it has been not improperly designated by the terms '*Hydarthrus*' and '*Hydrops articuli.*'

It more frequently happens that there is swelling from fluid in a joint, with inflammation and pain. Here we may presume that the disease consists in an inflammation of the synovial membrane, with a consequent increase of the secretion from its surface; and I have found this opinion to be confirmed by the appearances observed in many such cases, in which I had the opportunity of examining the affected parts after death.

In some instances, while there is still pain and inflammation in the joint, the fluid is felt indistinctly, as if a considerable mass of soft substance lay over it. Often, when the inflammation has subsided, and the fluid is no longer to be felt, the joint remains swollen and stiff; painful, when bent or extended beyond a certain point, and liable to return of inflammation from slight causes. The appearances observed on dissection, in the following cases, seem to throw light on this subject.

Case I.

A middle-aged man was admitted into St. George's Hospital in September 1810, on account of a disease in one knee. The joint was swollen and painful, with slight stiffness, and with fluid in its cavity. The swelling extended some way up the anterior part of the thigh, behind the lower portion of the extensor muscles. It subsided under the use of blisters and liniments. Two months after his admission into the hospital, the patient was seized with a fever, apparently unconnected with the disease in the knee, of which he died. On examining the affected joint, the synovial membrane was found more capacious than natural, so that it extended up the anterior surface of the femur at least an inch and a half higher than under ordinary circumstances. Throughout the whole of its internal surface, except where it covered the cartilages, the membrane was of a dark-red colour; the vessels being as

numerous, and as much distended with blood, as those of the tunica conjunctiva of the eye in a violent ophthalmia. At the upper and anterior part of the joint, a thin flake of coagulated lymph of the size of a half-crown piece was found adhering to the inner surface of the synovial membrane. There was no other appearance of disease, except that at the edge of one of the condyles of the femur the cartilage adhered to the bone less firmly than usual.

Case II.

A. B., a young man, in the spring of the year 1808, in consequence (as he supposed) of exposure to damp and cold, became affected with a painful swelling of one of his knees. Under the treatment employed by the practitioner whom he consulted, the pain and swelling in a great measure, but not entirely, subsided.

Three months after the disease first took place, he was admitted into St. George's Hospital. At this time the knee was swollen, painful, and tender. The swelling had the form of the articulating ends of the bones. The leg was confined to nearly the straight position, and admitted of very little motion on the thigh. His general health was unaffected.

Blood was taken from the knee by cupping, and afterwards it was rubbed daily with mercurial ointment and camphor. The pain and inflammation subsided; and the swelling and stiffness were in some measure lessened. It afterwards became necessary to amputate the limb on account of another disease. The operation was performed on the 15th of December, 1808, and I did not neglect the opportunity of examining the joint.

The bones, cartilages, and ligaments were in a natural state. The synovial membrane was increased in thickness to about one-eighth of an inch, and was of a gristly texture. It was closely attached to the surrounding cellular membrane and fascia by means of coagulated lymph, which had been formerly effused on its external surface.

Case III.

A middle-aged man, who laboured under an organic disease of the liver, was admitted into St. George's Hospital on the 19th of December, 1821, on account of a painful swelling of one knee. Blood was taken from the part by cupping, and afterwards blisters were applied. The affection of the knee was much relieved under this treatment, but the joint remained rather larger than natural, and somewhat stiff. The disease in the liver continued to make progress, and the man died on the 11th of February, 1822. On examining the body after death, the synovial membrane of the knee was found slightly thickened, and of a gristly structure. The vessels on its inner surface were more loaded with blood than under ordinary circumstances. The cartilage covering that portion of the articulating extremity of the femur which corresponds to the patella, in one spot of about three-quarters of an inch in diameter, presented an irregular surface, as if it had been partially absorbed, but not to a sufficient extent to expose the surface of the bone below.

The case which I am about to describe, did not occur under my own observation. The patient was under the care of Dr. Bence Jones in St. George's Hospital, who has kindly communicated to me the following particulars:—

Case IV.

January 24, 1850.—A stout healthy-looking servant-maid was admitted into St. George's Hospital, labouring under a very severe attack of acute rheumatism. She had been ill during the preceding week with pain, swelling, and redness of various joints, and much febrile excitement of the general system. On the tenth day after her admission, apoplectic symptoms suddenly supervened, and she died in the course of a few hours.

Each knee-joint contained rather more than a drachm of turbid

glutinous serum. In the upper part of each joint a mass of fibrine (coagulated lymph), about an inch and a half in breadth and the same in length, was found adhering to the surface of the synovial membrane. One of these masses was deeply stained with red blood, but no vessels could be detected in it. On removing them, the synovial membrane which was exposed was seen to be intensely red and highly vascular, presenting a striking contrast to the white shining cartilage, in which no vessels could be traced, and which was in no wise altered from its natural appearance.

One elbow-joint was examined. It contained a clear synovial fluid, but presented no appearance indicating the existence of inflammation.*

The foregoing cases seem to explain the usual consequences of inflammation of the synovial membrane. It occasions, 1st, a preternatural secretion of synovia; 2ndly, effusion of coagulated lymph into the cavity of the joint; 3rdly, a thickening of the membrane, a conversion of it into a gristly substance; and an effusion of coagulated lymph, and probably of serum, into the cellular texture by which it is connected to the external parts; 4thly, in some instances adhesion, more or less extensive, of the opposite surfaces of the reflected membrane to each other.

The synovial membranes which form the sheaths of the tendons, and the other bursæ in the neighbourhood, frequently partake of the inflammation of the synovial membrane of a joint. Examples of this complication are very commonly met with in the living person; and I have the notes of a case given to me many years ago by the late Mr. Howship, in which that industrious anatomist found the knee-joint distended with serum, having flakes of coagulated lymph floating in it; the inner surface of the synovial

* In addition to the above history, Dr. Bence Jones has furnished me with the following account of the result of a more minute examination of the fluid contained in the knee-joints:—It was alkaline, highly albuminous, containing many oil-globules; many cells, of the size of pus-globules, having well-marked nuclei, of a specific gravity greater than that of the albuminous liquid. Some cells were also nearly three times as large as the others, containing granular matter and nuclei. There were no cells in the synovial fluid of the elbow-joint.

membrane lined by a thin layer of lymph, easily separable from it; and the synovial membranes of the bursæ in the neighbourhood, also exhibiting marks of inflammation, and distended, like that of the knee, with a turbid serum.

The slight adhesion of the cartilage to the bone, in the first of the cases which have been related, and the partial absorption of it in the last case, must be regarded as the consequence of the greater disease in the synovial membrane, and as analogous to the ulceration of the cornea of the eye which may supervene in a case of severe conjunctival ophthalmia. In cases in which the inflammation has been more intense, or more than usually neglected, or protracted for a very long period of time, still more extensive changes ensue; the synovial membrane losing its natural structure, the cartilages becoming extensively destroyed by a process analogous to that of ulceration of soft parts, and the bones themselves being ultimately rendered carious.

The three following cases will sufficiently illustrate the foregoing observations.

Case V.

Robert Smith, 64 years of age, in the early part of December 1810, hurt his knee by slipping off a ladder. The accident was followed by pain and swelling of the joint, but not such as to prevent him following his usual occupation. A few days afterwards, in consequence (as it appeared) of exposure to damp and cold, the pain in the joint became much aggravated. He now became an out-patient of the St. Marylebone Parochial Infirmary. Under the treatment employed the pain and swelling in some degree abated. In the beginning of March 1811, he was admitted to the Infirmary as an in-patient. By means of the quietude thus obtained, combined with other remedies, his cure seemed to be completed, and in about three or four weeks he left the infirmary as convalescent. On returning to his business, however, the inflammation of the joint returned, and continued with repeated exacerbations and remissions until he was re-admitted to the

infirmary on the 6th of May. At this time he laboured under the ordinary symptoms of inflammation of the synovial membrane, the joint being much distended with fluid, and the membrane itself apparently thickened. He complained also of a most severe pain, which he referred to the interior of the joint.

The limb was kept in a state of perfect repose, and fomentations and blisters were had recourse to, which relieved the pain, and in a great measure removed the swelling. The patient's general health, however, which had been affected for some time, became worse: anasarcous swellings took place in the legs, and he died on the 23rd of July, 1811.

Through the kindness of Mr. C. Phillips, who was at that time surgeon to the infirmary, I had an opportunity of examining the diseased joint.

The parts external to the synovial membrane, including the ligaments of the joint, were in a natural state, except that the synovial membrane closely adhered to them by means of coagulated lymph. The synovial membrane itself was thickened, and there were still some marks of inflammation on its internal surface. In the cavity of the joint there was about an ounce of a reddish-coloured fluid. On the inner condyle of the femur the cartilage had been destroyed by ulceration, on a spot about half an inch in diameter, and a carious surface of bone was exposed. The cartilage on the inside of the head of the tibia was ulcerated to a still greater extent; and the internal semilunar cartilage was in a great measure destroyed by ulceration also. In the space between the two condyles of the femur, on which the patella rests, there was an ulcerated surface of cartilage of about the size of a silver penny; but the whole thickness of the cartilage at this part was not destroyed, and in consequence the surface of the bone was not exposed.

Case VI.

Robert Aldridge, 29 years of age, was admitted into St. George's Hospital on the 10th of November, 1836, under the care of Mr. Cæsar Hawkins.

The right knee-joint was considerably swollen, the swelling being for the most part composed of a solid and elastic substance. It was of an irregular shape, being most prominent anteriorly above the patella, and on the inside of the head of the tibia.

There were some superficial ulcerations of the skin covering the knee, and several cicatrices. At the upper part of the knee was an open sinus, into which a probe might be introduced to the depth of two inches, and from which there was a considerable purulent discharge. The joint was stiff, but not so as to prevent some degree of flexion.

The patient complained of pain, which, however, was not much aggravated by the attempts made to bend the limb, and not at all by the pressure of the articulating surfaces against each other.

He said that, six years ago, he had had a severe attack of rheumatism, affecting many of the articulations. Two or three months afterwards, an abscess presented itself, near the upper margin of the patella, which broke and discharged pus, and afterwards healed. Other abscesses formed afterwards, which also healed. Three years ago, he had another attack of rheumatism, also affecting several joints. After some time, the rheumatism again left him, the knee continuing, however, much enlarged.

On the 8th of December the limb was amputated.

On examining the diseased joint, the synovial membrane was found to have completely lost its natural structure. It was highly vascular, and much thickened, so that it projected towards the interior of the joint, covering the margin of the articulating surfaces. The cartilages were unaltered, and the bones were free from disease.

The joint contained a sero-purulent fluid. There was a large abscess in the ham, and several smaller abscesses in its neighbourhood, which did not, however, communicate with the articular cavity.

Case VII.

William Andrews, 48 years of age, was admitted into St. George's Hospital on the 28th of June, 1837.

One knee was considerably enlarged, the leg being fixed at an obtuse angle with the thigh. Pressure on the patella, or the least concussion of the foot, caused great pain in the joint. Otherwise it could not be said that the patient laboured under any disease, though he did not exhibit the appearance of robust health.

He said that in the course of the last ten years, he had suffered from numerous attacks of rheumatism, in all of which the knee had been more or less affected, and that it had been thus gradually brought into its present condition. He had not been able to leave his bed for six months previous to his being admitted into the hospital.

On the 3rd of August the limb was amputated.

On dissection of the diseased joint, the inner surface of the synovial membrane was found encrusted with coagulated lymph, thickened and in a pulpy condition.

The greater part of the articular cartilages had disappeared, leaving everywhere a carious surface of bone exposed, which bore marks of considerable vascularity. The portions of cartilage which remained had only a very slight adhesion to the bone beneath. The inner condyle of the femur and the corresponding part of the tibia, besides being wholly deprived of their cartilaginous coverings, were united by a dense mass of soft substance, resembling that of ordinary adhesions. In other parts there was a considerable quantity of pus, having flakes of lymph floating on it.

Any very extensive destruction of the articular cartilages by ulceration is, I believe, always attended with the formation of abscess in the articular cavity. There is, however, no necessary connection between these two processes. In a patient who recovered in St. George's Hospital, of an attack of inflammation of the synovial membrane of one knee, but who returned to the hospital, and died of another disease, several months afterwards, and in which there never had been any sign or suspicion of matter

being formed, I found, on dissection, that the greater part of the cartilage of the patella, and a small portion of that covering the condyles of the femur, had disappeared, its place being occupied by a thin membranous substance adhering to the bone and forming a distinct cicatrix. I mention this case as being more immediately connected with the subject of the present chapter; but I shall have to advert to other cases which tend to establish the same fact, on a future occasion. Whether the membrane by which the cartilage is thus replaced, ever assumes ultimately the structure of cartilage, remains to be determined by future observations.

As the cartilage of a joint may be destroyed by a process analogous to that of ulceration of soft parts, without suppuration, so the converse of this may happen; and acute inflammation of a synovial membrane occasionally terminates in suppuration, without any previous ulceration of either the soft or hard textures. Thus, in the case of a patient who died, after having received a punctured wound, which had penetrated into the elbow, I found the joint full of pus, although there was no ulcerated surface. There can be no doubt, that the same thing sometimes occurs, where the inflammation has not had its origin in a mechanical injury. The fact, however, can rarely be actually proved by dissection, as a softening of the cartilages, followed by their complete absorption, is always the result of the formation of an abscess, under such circumstances, in an articular cavity.

The fluid effused in consequence of inflammation of the synovial membrane, in the slighter cases of the disease, is transparent, differing little from ordinary synovia. In the more severe cases it is a turbid straw-coloured serum, sometimes with, at other times without, flakes of lymph floating in it. In some rare instances, the effused fluid is tinged of a red colour, in consequence of some of the colouring matter of the blood having been secreted with it. In a case related by Mr. Arnott, in his researches on Venous Inflammation, published in the fifteenth volume of the 'Medico-Chirurgical Transactions,' it is stated that the cavity of the knee-

joint was filled with a 'tolerably thick pus, of a uniform reddish colour, as if from an admixture of blood.' The following case affords a still more remarkable example of the secretions of an inflamed synovial membrane being tinged in the same manner.

Case VIII.

Henry Payne, 39 years of age, was admitted into St. George's Hospital, under the care of Mr. Cæsar Hawkins, on the 7th of October, 1829.

He had suffered, formerly, from repeated attacks of rheumatism.

About twelve weeks ago, after exposure to damp and cold, he was seized with inflammation in nearly all his joints. In the course of a few days, the disease in the other joints had abated; but the right knee became more painful and swollen. At the time of his admission, this knee was tender, painful, and much distended with fluid, and there was a good deal of febrile excitement of the system.

Blood was taken from the neighbourhood of the knee by cupping; and this was followed by the application of blisters. The *vinum colchici*, and afterwards calomel, combined with opium, were administered internally. Under this treatment the pain and swelling of the knee subsided.

On the 27th of October, he was attacked with severe inflammation of the fauces and larynx, which, however, soon yielded to the remedies employed.

On the 31st, he complained of severe pain in the right side, with great difficulty of breathing; and on the 3rd of November he died.

On examining the body after death, both pleuræ were found inflamed and incrusted with lymph, and serum had been effused into that of the right side. The lungs, also, were inflamed, and some portions of them were in a state of gangrene. The heart was affected with hypertrophy, and the pericardium was inflamed with flakes of lymph adhering to it. The synovial membrane of the right knee contained a dark-coloured fluid; not purulent, but

having the appearance of a thick synovia, tinged with blood. The synovial membrane was everywhere of a red colour, as if stained by this secretion, and the cartilages of the joint had the appearance of having been stained in the same manner. There were some small extravasations of blood in the cellular membrane external to the joint.

Section II.

Causes and Symptoms of this Disease.

It is evident that inflammation may affect the synovial membrane of a joint, by extending to it from some of the other textures of which the joint is composed, or that it may have its origin in the membrane itself. My present observations are intended to relate chiefly to cases of the latter description; and what little is to be said in addition, respecting those of the former, will be better introduced hereafter.

Although no period of life is altogether exempt from this disease, the liability to it is not the same in persons of all ages. It is seldom met with in young children, becomes less rare in those who approach the age of puberty, and in adult persons is perhaps of more frequent occurrence than any other inflammatory affection to which the human system is liable. This is the reverse of what happens with respect to some of the other diseases of joints; and a knowledge of these circumstances will be found to be of some importance to the surgeon, by assisting him to form a ready diagnosis.

Inflammation of a synovial membrane may arise as a local affection, the consequence of a sprain, a contusion, or other mechanical injury. In other cases, various joints being affected, either simultaneously or in succession, it is manifestly the effect of a disordered state of the general system; and even in those instances in which the inflammation is confined to a single joint, a careful inquiry will generally satisfy the surgeon that it has had

a similar origin. Indeed I must confess that, in proportion as I have acquired a more extended experience in my profession, I have found more and more reason to believe that local diseases, in the strict sense of the term, are comparatively rare. Local causes may operate so as to render one organ more liable to disease than another; but everything tends to prove that, in the great majority of cases, there is a morbid condition, either of the circulating fluid, or of the nervous system, antecedent to the manifestation of disease in any particular structure. Moreover, even in those cases in which a disease may be distinctly traced to some kind of mechanical injury, the character which it assumes depends as much on the state of the general health as on the injury itself. Thus we find a sprain of the ankle, in one instance, to be followed by no urgent symptoms, while, in another, a sprain not apparently more severe, is followed by intense inflammation, for the removal of which the most active antiphlogistic treatment is required.

The circumstances under which the synovial membranes are liable to become inflamed, are very various. It is only in a limited number of cases that the disease would commonly be ascribed to gout. Yet I am much mistaken if, among the affluent classes of society, the gouty diathesis be not one of the most frequent causes, not only of inflammation of the synovial membranes, but of inflammation of other organs. There is reason to believe that the real and efficient cause of gout is the presence of an unusual quantity of lithic acid in the blood; and, indeed, the fact has been established by the interesting researches of Dr. Garrod. But local inflammations are not unfrequently preceded by an abundant deposit of lithate of ammonia in the urine, and assuredly no long train of reasoning is required to connect inflammations occurring under these circumstances with the existence of gout in the general system. In such cases, besides the urinary deposit, the disease is generally preceded by flatulence after meals, acidity of the stomach, and other symptoms of disordered digestion.

In other cases, the usual indications of a gouty diathesis are

wanting. The disease may be traced to a checked perspiration, consequent on exposure of the person to damp and cold; and here we are justified in classing it with rheumatic, rather than with gouty, affections. If Dr. Prout's speculations as to the predominance of lactic acid in the system being the essential cause of rheumatism, as the predominance of lithic acid is that of gout; and the general opinion be correct that it is the lactic acid in which the secretion of the skin abounds, and which reddens blue litmus paper applied to the perspiring surface, the connection between a checked perspiration and a rheumatic inflammation of the joints is easily explained. It must, however, be acknowledged, that, practically, it is not always easy to distinguish a gouty, from a rheumatic, inflammation of a synovial membrane, and that whatever the acid of the perspiration may be, a want of perspiration which causes one individual to be liable to rheumatism, will render another person equally liable to gout.

There can be no doubt that we have yet much to learn as to the pathology of this class of diseases. Not only is it difficult to draw the line between those which belong to gout and those which belong to rheumatism; but it is probable, that under the general term of rheumatism, we frequently confound with each other diseases which have an entirely different origin. Thus, in the early stage of secondary syphilis, in connection with papular eruptions; and sometimes in the advanced stage of syphilis, in connection with chronic affections of the bones and periosteum; it is not uncommon to find the synovial membranes of one or more joints in a state of chronic inflammation. Such a case would not uncommonly be regarded as one of rheumatism, although the real cause of the inflammation is probably the syphilitic virus in the blood. In other cases the joints are similarly affected in consequence of the system having been saturated with mercury, or in connection with a depressed state of the general health, towards the conclusion of some other chronic malady; and under these circumstances also it is reasonable to believe that the real and efficient cause of the disease of the joints is not the same as in

those of ordinary rheumatism. I shall have occasion to notice hereafter some very remarkable cases of inflammation of the synovial membrane, preceded by purulent inflammation of the urethra and purulent ophthalmia to which the name of gonorrhœal rheumatism is commonly applied; though it must be plain to any one who has watched their progress, that the relationship of the disease to rheumatism extends no further than a partial resemblance in the symptoms. The facts seem to be, that there are various morbid conditions of the blood (and, it may be, of the nervous system also), producing a liability to local inflammations at the same time that the occurrence of the inflammation in one part rather than in another, is to be referred to the agency of local and accidental circumstances. That the synovial membranes should be more frequently the seat of inflammation than the serous membranes to which they bear so great an affinity in their structure seems to be in no wise remarkable when we consider that the organs to which they belong are in a state of constant motion, and that they are, except in a few instances, especially exposed to the influence of the vicissitudes of the external temperature.

The general symptoms which mark the existence of inflammation of the synovial membrane of a joint, may be described as follows:—There is pain in the joint, sometimes referred, in the first instance, to a particular spot, afterwards to the joint generally. After a period which varies from two or three hours to as many days, according to the intensity of the inflammation, the joint becomes swollen. The swelling in the first instance arises altogether from an effusion of fluid into the cavity of the synovial membrane. When the effusion has taken place rapidly and in large quantity, the distension may be so great that the fluctuation of the fluid is scarcely perceptible; but it is, in the early stage of the disease, very distinctive otherwise. It becomes less distinct when the inflammation has existed for some time, in consequence of the synovial membrane having become thickened, or from the effusion of lymph on its inner or outer surface; and in many

cases, where the disease has been of long standing, although the joint is much swollen, and symptoms of inflammation still exist, the fluid in its cavity is scarcely to be felt. As the swelling consists more of solid substance, so the natural mobility of the joint is in a greater degree impaired.

The form of the swelling deserves notice. It is not that of the articulating ends of the bones, and, therefore, it differs from the natural form of the joint. The swelling arises chiefly from the distended state of the synovial membrane, and hence its figure depends in great measure on the situation of the ligaments and tendons, which resist it in certain directions, and allow it to take place in others. Thus, when the knee is affected, the swelling is principally observable on the anterior and lower part of the thigh, under the extensor muscles, where there is only a yielding cellular structure between these muscles and the bone. It is also considerable in the spaces between the ligament of the patella and the lateral ligaments; the fluid collected in the cavity of the joint causing the fatty substance to protrude in these situations, where the resistance of the external parts is less than elsewhere. In the elbow the swelling is principally observable on the posterior part of the arm, above the olecranon, and under the extensor muscles of the fore-arm; and in the ankle it shows itself on each side, in the space between the lateral ligaments, and the tendons which are situated on the anterior part. In like manner, in other joints, the figure of the swelling, whether it arises from fluid alone, or joined with solid substance, depends in a great degree on the ligaments and tendons in the neighbourhood, and on the amount of resistance which they afford; and these circumstances, though apparently trifling, deserve our attention, as they assist us in forming our diagnosis.

In the hip and shoulder the disease occurs less frequently than in the superficial joints: and here the fluctuation of the effused fluid is not perceptible; but the existence of the swelling is sufficiently evident beneath the muscles.

When the shoulder is affected, there is pain accompanied with a

general tumefaction of the part; and, in most instances, if the hand be placed upon it, at the same time that the limb is moved, a crackling sensation is observed, which probably arises from an effusion of fluid into the cells of the neighbouring bursæ. After some time the swelling subsides, or the joint may even appear to be smaller than natural, in consequence of the muscles, especially the deltoid, having become wasted from want of exercise.

When inflammation attacks the synovial membrane of the hip, there is an evident fullness of the groin, and, sometimes, of the nates also. The groin is referred in the first instance to the hip itself, or to the inside of the thigh below the groin, and, in the most advanced stage of the disease, to the knee also.

After inflammation of the synovial membrane has subsided, the fluid is absorbed, and, in the majority of cases, the joint regains its natural size, figure, and mobility. In others it remains more or less stiff, and larger than its natural size. Such enlargement may be the consequence of a merely thickened state of the synovial membrane, and then the swelling has the form of the articulating extremities of the bones. At other times the swelling has the peculiar form which it possessed while the inflammation still existed, and while fluid was contained in the joint; and this is to be attributed, either to an effusion of lymph into the articular cavity, or to an actual alteration of structure of the synovial membrane. The alteration of structure which is here referred to has been already noticed, and in the following chapter, I shall have occasion to offer some further observations on the subject. From whichever of these various causes it be that the enlargement of the joint remains after the inflammation has subsided, the patient is very liable to a relapse; so that whenever he is exposed to cold, or the limb is exercised in any unusual degree, and often without any evident cause, the pain returns, and the swelling is augmented.

Although the foregoing observations are applicable to the majority of cases in which this disease exists, they will not be found to contain the whole of what belongs to any one of them; and it

remains for me to notice the peculiar circumstances as to which individual cases will be found to differ from each other.

Inflammation of the synovial membranes, like inflammation of other structures, may exist in various degrees of intensity. It may be acute, attended with violent pain and great constitutional disturbance; or it may be chronic, with little local suffering, and without the general system being in any perceptible degree affected by it. We distinguish therefore, the disease into the acute and chronic. In many cases it has the acute form in the beginning, and assumes the chronic form afterwards; while in others, there being no very urgent symptoms, it may be said to have the chronic form in the first instance.

It must be observed, however, that the boundaries of acute and chronic inflammation do not admit of being very well defined. These terms accurately enough express the two extremes; but there are numerous intermediate degrees of inflammation, of which it is difficult to determine whether they should be considered as being of the acute or chronic kind. On this, and on many other occasions, the pathologist must be content if he can succeed in pointing out the principal varieties of morbid action which occur, and the symptoms which they produce, in such a manner as will enable others, with the assistance of a certain degree of original observation, to distinguish those nicer shades in the characters of disease, which language is inadequate to explain, but a knowledge of which is of considerable importance in medical and surgical practice.

In some instances, the synovial membranes of two or more joints are inflamed at the same time, or the inflammation leaves one joint to attack another. But it more frequently happens, especially where it presents itself in the chronic form, that the disease is limited to a particular joint. It is worthy of notice, that the knee is more liable to be affected than any other joint in the body.

The pain which the patient suffers is more or less severe, according to the intensity of the inflammation. But it varies also

according to other circumstances. Thus, in some of those cases in which the inflammation seems to be connected with an acute attack of gout (this being indicated by the patient's general habit, by his liability to acidity of the stomach, and by a deposit of lithate of ammonia by the urine), the pain is often out of all proportion to the other symptoms of inflammation, the patient comparing it to what might be supposed to arise if the joint were compressed by a vice, or if it were violently torn open. The amount of pain depends, also, very much on the structure of the joint in which the disease is situated. The synovial membrane of the hip is much less liable to inflammation than that of the knee; but when it is inflamed, the pain produced is more severe. The synovial membrane of the knee is only partially covered by ligaments; and being itself of a yielding nature, it easily admits of distension, where it is covered by the extensor muscles of the thigh. On the other hand, the synovial membrane of the hip is everywhere, except in one small place, surrounded by, and adhering to, a dense strong capsular ligament, the fibres of which must necessarily offer a painful resistance to the distending force of the fluid accumulated in the articular cavity.

In cases of inflammation of the synovial membrane of the hip, if active treatment be not had recourse to in the first instance, there is always danger of the head of the femur being thrust outwards beyond the margin of the acetabulum, and then completely dislocated by the action of the muscles. Several cases of this kind of dislocation have fallen under my notice. From these I have selected the two following, as affording examples of its taking place in two different directions.

Case IX.

Master L., being at the time about eight years of age, was attacked towards the end of September 1824, with what was believed at the time to be inflammation of one of the parotid glands, attended with a good deal of fever. After six or seven days, and apparently in consequence of the application of cold lotions to the

cheek, the inflammation left the parotid gland, and attacked one shoulder and arm; and, at the end of two or three days more, it left the shoulder and attacked one hip. For six or eight weeks he suffered most severely from pain referred to the inside of the thigh, extending from the pubes as low down as within two or three inches of the inner condyle of the femur, and attended with a great deal of fever. There was no pain in the knee. The surgeon, who was then in attendance, applied leeches to the hip, lotions, &c., and afterwards made an issue with caustic behind the great trochanter. The fluctuation of fluid was perceived at the posterior point of the hip, and it was supposed that an abscess had formed. However, no puncture was made, and the fluid gradually became absorbed. In March 1825, Master L. was sufficiently recovered to be able to walk about, but it was discovered that the limb was shortened. In November 1825, I was consulted respecting him. At this time, there were all the marks of a dislocation of the hip upwards and outwards, the head of the thigh-bone being distinctly felt resting on the posterior part of the ilium, above the margin of the acetabulum, and the toes being turned inwards.

Case X.

Zachariah Price was admitted into St. George's Hospital, on the 18th of July 1838, labouring under an attack of what seemed to be rheumatic inflammation of the left hip. The hip was slightly swollen, the swelling being most perceptible in the neighbourhood of the great trochanter. A grooved needle having been introduced, through the muscles, into the posterior part of the capsule of the joint, some serum escaped by the puncture. The patient complained of much pain when the joint was moved, or when pressure was made on the swollen part; but little or no pain was produced when, the hand being placed on the knee and foot, the head of the femur was pressed into the socket of the acetabulum.

Pills of calomel and opium were exhibited, blisters were applied to the hip, and the limb was kept in a state of complete repose.

On the 27th of October, the limb was found to be in the following condition:—

The form of the hip was considerably altered from what it was at the time of the patient coming to the hospital. The head of the femur could be distinctly felt anterior and internal to the acetabulum. The great trochanter was nearer to the anterior and superior spinous process of the ilium, than that of the other side, by about an inch. The foot was everted, and the limb was an inch shorter than that of the other side. Bending the thigh on the pelvis caused excessive pain, and the limb could not be rotated inwards.

On the 8th of November, a swelling was discovered on the inside of the thigh, near the groin, which, some time afterwards, presented itself, having much the character of an abscess, in the perineum. It was, however, probably, only a collection of serum, as it was gradually absorbed.

March 13, 1839, he left the hospital, being free from pain, and able to walk with a stick, the position of the limb being the same as in October.

It is to be presumed that in such cases the internal ligament of the hip either becomes stretched and attenuated until it at last gives way, or that it is altogether absorbed. In one case which I had reason to believe to have been a dislocation of the same kind, and which I had the opportunity of examining after death, I ascertained that there had been no rupture of the capsular ligament; but that the superior and posterior attachment had gradually shifted its place from the margin of the acetabulum to the dorsum of the ilium above it, so that although the head of the thigh-bone was no longer in the acetabulum it might be said to be still within the joint. I conclude that the fluid, which in each of these cases was perceptible externally, but was afterwards absorbed, was not pus but serum. This is different from what happens in those cases which I shall have to notice hereafter, in which dislocation

of the hip occurs as a consequence of simple ulceration of the cartilages, or of scrofulous disease, originating in a morbid state of the cancellous structure of the bones. In these last-mentioned cases the formation of abscess is almost an invariable result. The distinction is of great importance in practice. The opening of an abscess of this kind is useful, as it prevents the extension of the mischief among the soft parts of the limb; while the opening of a tumour containing serum, is often productive of the worst consequences, by inducing an extensive suppuration where there would have been no suppuration otherwise.

The hip is not the only joint in which a displacement of the bones may arise as a consequence of inflammation of the synovial membrane. When the knee has been for some time distended with fluid, the ligaments being thus extended and elongated, and the leg having been kept at a right angle to the thigh, the head of the tibia is not unfrequently drawn back by the action of the flexor muscles, and lodged in the popliteal space. The condyles of the femur are then seen, making an unnatural projection in the forepart of the limb, and the leg is ever afterwards incapable of complete extension. In other cases, where, during the existence of the inflammation, the leg has remained in the extended state, such is the relaxed condition of the ligaments afterwards, that the head of the tibia seems to be very loosely connected to the femur, and admits of a free lateral motion on the condyles of the latter.

In some instances, where the synovial membrane has been for some time in a state of inflammation, a peculiar crepitus attends the motion of the joint, which not only may be heard at some distance, but is plainly to be distinguished by the touch. This symptom may be entirely independent of any absorption of the cartilage, as after the inflammation has subsided, the crepitus is no longer perceptible, and it is best explained by attributing it to an alteration in the secretion of the synovial membrane, rendering it unfit for the purposes for which it is designed, of lubricating the articular surfaces.

In other cases, after a long-continued inflammation of the

synovial membrane, on examining the knee-joint, a sensation is communicated to the hand as if it contained a number of small loose bodies, certainly of a different nature from the loose cartilages which are met with in other cases, of which I shall give an account hereafter. I suspect that the substances here referred to are portions of coagulated lymph, which had been effused from the inner surface of the synovial membrane, and had afterwards become detached, similar to those which are not unfrequently formed in the cavity of an inflamed synovial bursa. I have not, however, had the opportunity of determining the correctness or incorrectness of this opinion by dissection.

I have already mentioned that in some (but certainly rare) instances, inflammation of the synovial membrane proceeds at once to suppuration. In these cases the symptoms are always urgent, the pain very severe, and aggravated by the slightest touch or motion, and there is great constitutional disturbance, indicated by heat of skin, frequency of the pulse, a furred tongue, and probably rigors. The absorption of the cartilages under these circumstances seems to be the consequence, and not the antecedent, of the suppuration.

In a much greater number of cases, the order of events is different, the formation of abscess being preceded by the ulceration of the cartilages. I shall have occasion to offer some further remarks as to the process by which the cartilages are destroyed, in a future Chapter. It is sufficient for me to observe at present, that such an extension of the disease is, for the most part, indicated by a new and almost intolerable pain in the joint, with painful startings of the limb, preventing sleep; and that, after some time, suppuration follows. The latter, however, as indeed I have formerly stated, is by no means a necessary consequence. I have already mentioned a case in which a distinct and well-formed cicatrix, not at all interfering with the motions of the joint, marked the spot at which the cartilage had disappeared. In other cases, an extensive destruction of the cartilage is followed by complete ankylosis, without any sign of suppuration.

In the labouring classes of society, we meet with many cases in which a chronic inflammation of a joint, especially of the knee, has been neglected during many successive years. Whenever he has had more than usual suffering, the patient has confined himself to the house, or sought relief in a hospital. Having experienced some degree of amendment, without waiting for a cure, he has returned to his accustomed occupations which he has again been compelled to abandon by a return of his former symptoms. After many of such alternations, the joint after each of them being in a worse state than it was in before, unable to gain his livelihood, suffering from hectic fever, and regarding his limb as an useless incumbrance, he has been glad to obtain such relief as is afforded to him by amputation. Under these circumstances, an abscess very commonly presents itself externally, somewhere in the neighbourhood of the diseased joint; or otherwise an abscess is discovered on dissection, sometimes occupying the whole of the articular cavity, at other times limited to a portion of it by a mass of imperfectly organised lymph. In such a case, no one of the parts of which the joint is composed, retains its healthy condition. There are no remains at all, or only some imperfect remains, of the cartilages; the bones are ulcerated, their cancelli being exposed, and frequently of a dark, or even of a black colour. There is scarcely a vestige of the original structure of the synovial membrane. These morbid appearances furnish us with no means of determining what was the nature of the disease in its origin, and our diagnosis must be founded altogether on the previous history. Fortunately in this extremity an accurate diagnosis is of no great importance, as it can lead to no essential difference in the surgical treatment of the case.

I have already adverted to a peculiar disease, of which inflammation of the synovial membranes is the principal feature, but in which that inflammation occurs in connection with purulent inflammation of the urethra, and sometimes with purulent ophthal-

mia. Cases of this kind are not very uncommon, and are now well known to every practical surgeon; though it is a remarkable circumstance, that no distinct account of them should have been given (as far as I know) by any pathological or surgical writer, previously to the first edition of the present treatise in the year 1818. The disease is usually described under the name of gonorrhœal rheumatism, though it is plain (as I have already stated) from the course of its symptoms and from the effects of remedies, that it differs from ordinary rheumatism in many essential circumstances; and though there seems to be no doubt that, while it occurs in most instances as a consequence of gonorrhœa, it may take place quite independently of gonorrhœal infection.

The following case, being one of those which first drew my attention to the subject, will explain the general course and progress of the symptoms.

Case XI.

A gentleman, forty-five years of age, in the middle of June 1817, became affected with symptoms resembling those of gonorrhœa. There was a purulent discharge from the urethra, with *ardor urinæ* and chordee. On June 23, he first experienced some degree of pain in his feet. On the 24th, the pain in the feet was rather increased, but not in a sufficient degree to prevent his walking four miles. There was some appearance of inflammation of his eyes.

June 25th.—The pain in the feet was more severe; the *tunicæ conjunctivæ* of the eyes were much inflamed, with a profuse discharge of pus.

These symptoms increased in violence, the pulse varying from 80 to 90 in a minute, the tongue being furred and the patient being restless and uncomfortable during the night. The whole of each foot became swollen; there was inflammation of the synovial membranes of the ankles; and, it appeared that the affection of the feet themselves arose from inflammation of the synovial

membranes belonging to the joints of the tarsus, metatarsus, and toes. He said that he could compare the pain which he experienced to nothing else than that which might be supposed to arise from the feet being squeezed in a vice.

On June 27, the left knee became painful; and on the following day, the synovial membrane of this joint was found exceedingly distended with synovia. He was now completely crippled, compelled to keep his bed, and scarcely able to vary his position in the smallest degree without assistance. The inflammation of the eyes and urethra was somewhat abated.

June 30.—The inflammation of the eyes and urethra had much subsided, and the purulent discharge was diminished. The pains of the joints were less severe; and the feet were less swollen. On the following day, the knee was less swollen also.

He continued to mend; and on July 10, the swelling of the feet was still further diminished, and that of the knee had almost wholly disappeared. The pulse continued to vary from 80 to 90 in a minute, and the tongue was still furred. He had pain in the feet and knee, but less severe than formerly, and he was restless at night.

July 13.—He complained of pain in the right knee; and on the following day, there was pain also of the right elbow and shoulder.

The right knee afterwards became swollen from fluid within the cavity of the synovial membrane; but not in the same degree with the other knee, and the swelling soon subsided. There was never any perceptible swelling of the shoulder or elbow.

August 1.—All the pains were abated. The eye and the urethra were nearly free from inflammation, and the purulent discharge was scarcely perceptible.

August 5.—He was free from pain, except on motion; the joints which had been affected, were stiff; but he was able to move about on crutches.

From this time he progressively mended. The stiffness of the joints diminished very slowly; but he was free from all uneasiness.

He was longer in recovering the use of the shoulder than that of the other joints.

In the following December, at which time he had nearly, but not completely, recovered the use of his limbs, he had another attack of the complaint. The symptoms were the same as formerly, taking place in the same order, and pursuing the same course, but with much less severity. This second attack lasted about six weeks, and left him again considerably crippled.

In March 1818, he became affected with an ophthalmia of a different nature from that under which he had laboured in the preceding summer. The inflammation was seated in the proper tunics of the eye, and it seemed probable that it would have terminated in adhesions of the iris, and destruction of the power of vision, if the progress of it had not been arrested by repeated blood-lettings and the use of mercury. He had another attack of the same kind of ophthalmia four years afterwards (in 1822).

From this period I have no written notes of the case, although I saw the patient from time to time. He never had any return of the inflammation of the synovial membranes or the purulent ophthalmia, but no year elapsed without an attack of acute iritis. Each attack left the eye with its organisation more impaired than it had been previously. At last the power of vision in one eye was completely destroyed, while that in the other was very imperfect. In the year 1846, the patient was seized with an attack of pleurisy, which terminated his life.

As the subject does not belong to the present chapter, I have described the symptoms of this case without adverting to the treatment which was employed. I may, however, briefly mention that leeches and blisters, and liniments and fomentations when the pains were very severe, were the principal topical remedies. The *vinum colchici* was administered internally with some apparent benefit when the synovial membranes were inflamed; and the abstraction of blood from the temples, and the exhibition of mercury, were always employed with the greatest advantage during the attacks of iritis.

I have had the opportunity of seeing many other cases, in which a similar train of symptoms took place.

One gentleman (at the time when these notes were taken) had suffered from as many as nine attacks of this complaint. The first took place when he was under twenty years of age, and the others at various intervals in the course of the next twenty years. In one of them the first symptom was inflammation of the urethra, attended with a discharge of pus, although, from particular circumstances, he could not believe that he had been exposed to the risk of infection. This was followed by purulent ophthalmia, and that by inflammation of the synovial membranes. In three of the attacks, a purulent ophthalmia was the first symptom, which was followed by inflammation and discharge from the urethra; and then the synovial membranes became affected; and in the other four attacks, the affection of the synovial membranes took place without any preceding inflammation either of the eye or urethra. The disease was not confined to the synovial membranes of the joints, but those of the synovial bursæ were inflamed also. In some of the attacks, the muscles of the abdomen were painful and tender, and subject to spasmodic contractions; and there was an occasional impediment to breathing, which seemed to arise from a similar affection of the diaphragm. The acute form of the disease, in this case, lasted from six weeks to three months; but nearly a year generally elapsed before the use of the limbs were perfectly restored. He had an attack in July 1817; and in the beginning of May 1818, while he was still lame, he was seized with a very violent inflammation of the sclerotic coat and iris of one eye, which was subdued by very copious blood-letting and the exhibition of mercury. He had another attack of the disorder in the year 1820, and in the winter of 1822 he became affected with an inflammation of the iris and sclerotic coat of the other eye, which was also relieved by blood-letting and the use of mercury.

Another gentleman gave the following history of his complaints: —In the year 1809, he had symptoms resembling those of gonorrhœa, and when these had continued for some time one testicle

became inflamed and swollen. This was followed by a purulent ophthalmia, and inflammation of the synovial membranes. In the year 1814, he had a similar attack, with the exception of the swelled testicle; and in the year 1816, when I was consulted, he still laboured under a chronic inflammation of the synovial membranes of the knees and ankles, the consequence of the last attack, and by which his lower limbs were completely crippled.

In a fourth case, the patient laboured under a severe ophthalmia, which was followed by inflammation of the urethra, and then the joints became affected; but I had no opportunity of watching the progress of this case, nor have I heard any other particulars of it.

In another case, the patient laboured under strictures of the urethra. He had four attacks of the disease which has been just described, in the course of a few years. The inflammation of the urethra was in all of them the first symptom, being followed by purulent ophthalmia, and afterwards by inflammation of the synovial membranes, and swelling of nearly all the joints. In two of these attacks, he attributed the discharge from the urethra to his having received the infection of gonorrhœa; and in the two others, to the use of the bougie.

In the ordinary and less complicated cases of this disease, there is generally an attack of gonorrhœa, having its usual origin, which after a few weeks is followed by inflammation of the synovial membrane of one or more of the articulations. Sometimes the symptoms of gonorrhœa subside before the synovial membranes become affected; at other times, the two orders of symptoms run their course together. In some instances, the disease subsides after the lapse of a few weeks; in others, it is protracted for several months, or even for one or two years. The inflammation is for the most part of that kind which terminates in an effusion of serum, and not of coagulated lymph. But sometimes it is more intense, leaving the synovial membrane thickened, and the joint more or less stiff; and I have known a few instances in which the cartilages became ulcerated, with great pain to the patient at the time, ankylosis being the ultimate result.*

* The etymology of the term ankylosis does not justify the sense in which it is commonly used; but I do not undertake so great a task as that of reforming

There is a disease which appears to commence with inflammation of the synovial membrane, this being, however, only the first of a series of changes of a peculiar character, which ultimately affect the whole joint, producing a morbid condition of the various structures of which it is composed, wholly different from what is found to exist under any other circumstances. The cases here referred to, are very slow in their process. There is no tendency to suppuration, nor to anything like the ordinary process of ulceration. In some instances, a deposit of lithate of soda, both within the joint and externally to it, marks the connection of the disease with a gouty habit. In others, the deposit of lithate of ammonia is wanting; but as the changes which occur are in other respects similar, we are justified in regarding the two orders of cases as bearing a near relation to each other. Indeed, judging from the symptoms alone during the patient's lifetime, it can rarely happen that the surgeon will be able to give a positive opinion as to the presence or absence of the gouty concretion. Practitioners generally recognise this disease under the name of *rheumatic gout*; and it must be owned that it has a more than a mere imaginary resemblance both to chronic gout and to chronic rheumatism, and such as to justify this appellation.

These observations, however, are here introduced, only because the present Chapter would appear to be incomplete if the subject were left altogether unnoticed. As, both in its symptoms, and in its results, the disease essentially differs from the ordinary forms of synovial inflammation, it seems to require a separate consideration, and for this reason I reserve a more extended history of it for a future Chapter.

anatomical and pathological nomenclature. Indeed, the substitution of new terms for those which have been long in use is productive of so much inconvenience, that, except under some peculiar circumstances, it is better that it should be avoided.

Section III.

Treatment of this Disease.

Although different diseases of joints may require different modes of treatment for their relief, there is one rule which is equally applicable to all of them:—The diseased joint should be kept in a state of absolute and complete repose. Every motion of the bones on each other tends to maintain and aggravate the morbid action, whatever it may be. If this rule be neglected, it will be of little use to have recourse to other remedies; and if it be observed, it will often happen that some very simple remedies in addition will be all that is wanted for the cure.

In cases of acute inflammation of the synovial membrane of a joint, where swelling rapidly takes place, with severe pain and great external tenderness, the pressure of a bandage (without which no efficient mechanical contrivance for the purpose of restraining the motions of the parts on each other can be employed) cannot be borne. Nor, indeed, under these circumstances, is the interference of the surgeon, for the above-mentioned purpose, much required. The pain which the patient experiences on every movement of the limb, is a sufficient guarantee that he will use his best endeavours to keep it in a state of repose. These may, however, be assisted by prescribing the maintenance of the recumbent posture, and by laying the affected joint on a water-proof pillow partially distended with air or water, which, by bulging forward on each side, will give sufficient lateral support to counteract, in some degree at least, the ill-effects produced by an involuntary starting of the limb.

Whatever difficulty there may be in the application of mechanical means, for the purpose of insuring the repose of a joint which is the seat of acute inflammation, there is no such difficulty, where the inflammation has assumed the chronic form. And here, in fact, mechanical aid is more required. In a case of chronic inflammation the motion of the joint may occasion little or no incon-

venience at the time, although it invariably tends to aggravate the symptoms afterwards. It is difficult to persuade a patient thus situated to submit to a very rigid system of confinement; and if he should do so, there is always danger, in protracted cases, that his general health will suffer in consequence. It is important that he should not be altogether deprived of the opportunity of taking air and exercise, yet it is necessary that the affected joint should be kept in a state approaching as nearly as possible to one of complete repose. This double object may be attained by means of a proper bandage, applied so as to restrain the motions of the joint, at the same time that it makes no more than a moderate degree of pressure on it. As to the best mode of carrying this plan into execution, the surgeon must exercise his own judgment in each individual case. Much will depend on the situation of the affected joint. In the case of the knee, elbow, and many other joints, a very convenient method is that of applying a large quantity of calico bandage, with adhesive plaster, in several alternate layers. The principal objection to this plan is that, in the event of any fresh access of inflammation with a sudden increase of swelling, the bandage would become too tight, and cause great suffering to the patient. On this account it should not be drawn very tight in the first instance; the adhesive plaster should be applied in strips of moderate length, so that it may nowhere completely surround the limb, and the patient should be instructed as to the mode of removing the bandage himself if that should be required, without waiting for the assistance of the surgeon. The starch bandage should never be had recourse to, on these occasions. I was called to a lady who laboured under a disease of the knee, and for which a surgeon had surrounded the joint with a long roller imbued with a solution of starch. This at first had given her a not uncomfortable support. But a fresh attack of inflammation having supervened, she began to experience pain, which soon became intolerable. She was unable to remove the bandage herself; and when I saw her, her sufferings were such as can scarcely be expressed in words. In fact, the joint, if I may use

the expression, was trying to swell, and the hard starch bandage acted like a hoop of iron, and prevented the swelling from taking place. It was as if a ligature had been drawn as tight as possible round a whitlow, except that, the part being larger, the pain was in proportion. Of course, I removed the starch bandage, and the violence of the pain abated. It was long, however, before the effects produced by the compression of the joint under these unfortunate circumstances, were wholly removed.

There is a bandage * which is very well suited to cases of this kind, and especially applicable to the knee-joint, composed of a stiff leather in one part of its circumference, and elsewhere of small spiral wires, interposed between two layers of a softer and thinner material, and secured by a lace, so that it admits of being applied with any degree of tightness, and at once loosened if necessary. In some instances, much support may be wanted, and the leather should be stiff and unyielding. In others, where little support is required, it may be somewhat more pliant. Such a bandage is worn with the greatest comfort, and in the slighter cases it fully answers the intended purpose. As it may be easily removed by the patient's own hands, the use of it is quite compatible with that of the stimulating liniments of which I shall have occasion to speak hereafter.

But in the more aggravated cases of this disease, where there is an effusion of lymph as well as of serum into the joint, or where the synovial membrane itself is thickened, and still more where there is reason to believe that the disease is affecting the harder textures, these simpler methods of confining the joint will be found to be quite insufficient. The plan which I generally have recourse to, under these circumstances, is that of applying a broad leathern splint † on each side of the limb, or on one side only, according to the joint that is to be supported, the splint, or splints,

* The bandage here referred to is made by Schoolbred and Co. in Jermyn Street, London.

† Splints of this kind are made by Mr. Sparkes, bandage-maker, of Conduit Street.

being secured by a suitable bandage. The splints are made of thick stiff cow-hide, softened in hot (not boiling) vinegar, neatly moulded to the figure of the parts, and allowed to dry on them. These must necessarily give an uniform and complete support, and hence are easy to be worn. They insure the actual immobility of the joint, at the same time that they may at any time be removed and readjusted by the patient himself. In ordinary cases, they may be lined with some soft leather, for which oiled silk may be substituted where there is an open abscess or sinus, to prevent the leather being soiled and rendered offensive by the discharge. Similar splints may be made of the gutta-percha; but on the whole I have found those made of the stiff leather to be preferable.

In cases of acute inflammation of the synovial membrane, where the patient is of a strong and plethoric habit, and the symptoms are urgent, it may occasionally be proper to abstract blood from the arm; but in the greater number of instances it is sufficient to take blood from the neighbourhood of the inflamed joint, by leeches or cupping. This may or may not be repeated according to circumstances. Warm fomentations are generally more effectual in relieving pain than cold applications. Calomel, followed by an active aperient, may be administered in the first instance, and saline and antimonial medicines afterwards.

Where, from the patient's habit and the character of the symptoms, there is reason to believe that the inflammation is of gouty origin, ℿxv of the wine of colchicum may be given twice or three times daily, after the bowels have been thoroughly evacuated. This need not be continued for more than four or five days, that time being quite sufficient for the colchicum to have produced whatever advantage is likely to arise from its use. For the most part, indeed, the use of the colchicum even for so long a period as this, is not required.

Wherever colchicum is administered, it appears to me to be advisable to give some small doses of the *pilula hydrargyri*, or some other preparation of mercury, at the same time, with a view to prevent the former remedy from arresting the secretions of the

liver. But there are other cases in which mercury may be given in larger doses, and for a wholly different object. In this, as in many other instances, mercury exercises a remarkable influence over inflammatory action. To an adult man two or three grains of calomel, with half a grain of opium, may be administered twice, and in urgent cases three times daily. The object is to place the system as speedily as possible under the mercurial influence. It is seldom necessary to continue the use of it more than a very few days, and it may be left off sooner, or the dose greatly diminished, if the gums become affected by it.

When the knee-joint has been much distended from an effusion of serum into it, and the patient has been suffering severely in consequence, I have sometimes ventured to make punctures with a narrow sharp-pointed instrument, drawing off some of the fluid afterwards by means of an exhausted cupping-glass. I have not known any harm to arise from this practice; but as the relief which it gives is only temporary, and as I cannot be certain, without further experience, that it is always free from risk, I do not much recommend it. The case is different where acute inflammation of the synovial membrane has proceeded rapidly to suppuration, and the joint is distended with pus. Serum effused into a joint will be absorbed as soon as the inflammation which caused the effusion has subsided. But it is doubtful whether pus once formed, is ever absorbed; and at all events, the chance of it being absorbed under the circumstances which have been just mentioned, are so small, that they may be regarded as none at all.

If it be a question whether a collection of fluid in a joint be purulent or otherwise, it is prudent, in the first instance, to make a puncture with a grooved needle. If it prove to be purulent, a free opening should then at once be made with a lancet in a depending situation. It is important that this operation should not be long delayed, lest the matter should make its way out of the joint in other directions, and form irregular and circuitous sinuses among the neighbouring tendons and muscles. It is equally important that the opening should be sufficiently large to

allow the matter to flow spontaneously without it being necessary to have recourse to pressure on the joint. If afterwards there be reason to believe that there is still a lodgement of matter in any part of the joint or among the neighbouring soft parts, the original opening should be dilated, or the surgeon should avail himself of the first opportunity which occurs of making another opening in a convenient situation; and it will often happen that several such openings will be required before the cure is completed.

But all this will be of little avail unless the joint be kept in a state of the most complete immobility. At first we can do little more than support the limb on a pillow, and endeavour to impress on the patient's mind the necessity of his aiding our views in this respect. Afterwards we may with great advantage apply some kind of splints, those made of leather being preferable to others.

At the same time great attention should be paid to the state of the general health in all respects; saline medicines, or tonics, or mineral acids, being administered according to circumstances. Of course care must be taken to prevent costiveness; but on this, as on all other occasions where perfect quietude is required, very active cathartics should be avoided.

Under this treatment we may expect the purulent discharge to lessen by degrees, and at last to cease altogether, as ankylosis becomes established. Before ankylosis is complete, the surgeon should endeavour cautiously and gradually to place the limb in that position which may be most convenient to the patient afterwards: thus if the elbow be the seat of the disease, it ought, if possible, to be ankylosed in a state of flexion; or if it be the knee, the leg should be nearly but not quite, extended on the thigh. It will be sometimes necessary to apply splints of different forms at different periods. Where the knee has been affected, I have frequently employed a wooden splint, consisting of two parts, one adapted to the posterior part of the thigh, the other to the posterior part of the leg, united by a hinge, and furnished with a long screw behind, by means of which the relative position of the leg and thigh may be gradually and cautiously altered.

The foregoing remarks are applicable only to those cases in which an abscess in the interior of a joint is the immediate consequence of acute inflammation. The management of abscess arising as the ultimate result of a long-continued chronic inflammation will be considered hereafter. It is scarcely necessary for me to add, that the treatment which is here proposed is also inapplicable to those joints which are clothed by numerous muscles, as the hip and shoulder, in which, in fact, it is impossible to form a positive opinion whether abscess does or does not exist, until it must be too late to make an opening into the joint even if such an operation could at any period be performed with prudence.

In cases of chronic inflammation of the synovial membranes, local blood-letting may often be had recourse to with advantage, in the first instance. This may be repeated or not, according to circumstances, and in the intervals compresses may be laid on the part wet with some cold spirituous lotion. The application of blisters may be useful afterwards, and I have generally found the application of two or three blisters in succession to be preferable to that of a single blister kept open with the savine cerate. The blisters should be of a considerable size; and if the affected joint be deep-seated, they may be applied as near to it as possible; but, otherwise, a blister is frequently of more service when applied at a little distance. For example, if the synovial membrane of the hip be inflamed, the blister may be placed on the groin or nates; and if the disease be in the knee, it may be applied to the lower part of the thigh, immediately above the joint. The good effects of this treatment are soon manifest; and in a few days, the swelling, as far as it depends on fluid collected in the joint, is usually much diminished. Even when the tumour is solid, arising from the effusion of coagulated lymph, it will in a considerable degree subside, and sometimes be entirely dispersed, provided that the lymph has not yet become organised. Blisters are of more service, with respect to the removal of the swelling, than any other

applications; but they should not be employed without the previous abstraction of blood, except when the inflammation is slight, and when fluid is effused without any admixture of solid substance.

After the application of blisters, and in slighter cases in which the use of blisters seems not to be required, stimulating liniments, applied to the skin over the affected joint, will be found useful as counter-irritants. One drachm of iodine may be dissolved in ℥j. or ʒx. of rectified spirit, and the whole surface of the joint may be painted once or twice daily with this solution, by means of a large camel's-hair brush, until the skin is tender. It may then be omitted for two or three days, the use of it being resumed afterwards. Various other liniments, however, may be employed with as much advantage as this. One of the most efficient which I have been in the habit of using, especially in hospital practice, is the following:—

℞. Olei Olivæ ℥ iss.
Acidi Sulphurici ʒ iss.
Misce, et adde gradatim
Olei Terebinthinæ ℥ ss.
Misce. Fiat linimentum.

It may be made of this strength for the class of persons who apply at a hospital for relief; but for those of a higher grade in society, in whom the cuticle is generally thinner, and the cutis more tender, the proportion of the sulphuric acid should be somewhat less. The effect of this liniment is to excite some degree of inflammation of the skin: the cuticle becomes of a brown colour, and separates in thick broad scales; and the inflammation of the internal parts is relieved, on the same principle as by a blister. Another liniment, which is also very useful, is one frequently recommended, consisting of a drachm (or more) of the *antimonium tartarisatum* mixed with an ounce of the *unguentum cetacei*.*

* There is one objection to the use of the ointment of tartarised antimony which, as far as I know, has not been noticed by writers. It occasionally excites an eruption of small pustules over the body. The eruption is preceded by fever, and the pustules are very similar in appearance to those produced by the local application of the ointment.

This produces a pustular eruption of the skin, which, like other eruptions of the same kind, runs its course, and during a certain period of time, operates very beneficially, on the same principle as other counter-irritants, by abstracting blood from the deep-seated parts. There are various kinds of stimulating plasters (for example, the *emplastrum ammoniaci cum hydrargyro*) which produce the same effects. There is no objection to the use of them, though it appears to me that the other methods of exciting external irritation are, on the whole, more convenient.

But in cases of chronic, as in those of acute, inflammation of the synovial membranes, it often happens that more depends on the constitutional treatment than on any local remedies. The patient may have a furred tongue, with costive bowels, and other marks of derangement of his digestive organs, and may derive benefit from the exhibition of alterative doses of the *pilula hydrargyri*, with a draught of compound decoction of aloes and infusion of senna administered every morning, or a more active aperient occasionally. He may be flatulent after his meals, suffering from acidity of the stomach, with a red or yellow deposit in his urine, and alterative doses of the acetic extract of the colchicum may be added to the mercurial pill. In cases in which the disease may be traced either to gout or rheumatism, the iodide of potassium is frequently very useful. Two or three grains administered twice daily will be sufficient, but in these doses the use of the remedy may be continued for some weeks. The *liquor potassæ* may be added to it with advantage, in some cases of dyspeptic persons; and those who complain of being lowered or depressed by the use of the iodide alone, will find those ill effects counteracted by substituting the sesquicarbonate, or some other preparation of ammonia, for the other alkalies.

Where inflammation of the synovial membrane occurs in conjunction with the early symptoms of secondary syphilis, it generally yields to the use of mercury. In the more advanced stage of syphilis, sarsaparilla may be given, either alone or in conjunction with mercury, or the iodide of potassium. Sarsaparilla, and

whatever tends to the improvement of the general health, may be had recourse to, where the disease is the result of the incautious use of mercury, or where in consequence of some peculiarity of constitution, mercury has disagreed with the patient.

Where the disease occurs in individuals, whose bodily powers are exhausted by over exertion, or long previous illness, and is to be regarded as a symptom of general debility, the patient may derive benefit from sea air, the use of warm sea-baths, and from various tonics, such as the sulphate of quinine, the citrate of quinine and iron, or the decoction of cinchona, the latter being exhibited alone or in conjunction with guaiacum, and combined with a generous but prudent diet. In short, the same rule applies to these as to all other cases of local disease. If any of the animal functions be in any way deranged, the surgeon should endeavour, by suitable remedies, to restore them to a healthy condition.

Of the diseases which are not actually hopeless and incurable, few are more intractable than that peculiar inflammation of the synovial membrane, which occurs in conjunction with purulent inflammation of the urethra, and sometimes with purulent ophthalmia. In these cases, and in the commencement of the attack, I have generally found the most advantage to be derived from the exhibition of saline medicines, combined with the wine of colchicum, and occasional aperients; leeches, cupping, and blisters being at the same time had recourse to, according to circumstances. In a more advanced stage of the disease, I believe that the iodide of potassium is sometimes useful. In the great majority of cases, however, it seems to me that the disease must run its course, and that all that can be done, either by the surgeon or the patient, is to guard against the operation of those causes which might tend to aggravate or renew the symptoms. Irregularities as to diet, and a careless mode of life otherwise, and exposure to damp and cold, are especially to be avoided.

I have known some cases in which the patient after having derived little or no advantage from various methods of treatment in our damp climate, has obtained very great benefit, and indeed

a perfect cure, from a residence in the south of Europe; and I have no doubt that for any one who is thus afflicted, and whose circumstances enable him to do so, it is worth while to have recourse to this experiment. One gentleman, who has suffered from this disease in an unusual degree, recovered in Italy, and after being there for several months returned to England. Immediately on his return, however, there was a recurrence of his former symptoms, which again subsided on his going back to Italy.

In ordinary cases, after the inflammation of the synovial membrane has subsided, a joint is sustained so nearly in its natural condition, that no further treatment is required. But it is not so in all cases.

1. I have already observed that where the distension, from the effusion of fluid into the joint, has been very great, not only the synovial membrane, but the ligaments also are left so extended and relaxed, that the bones are preternaturally movable on each other. Under these circumstances it will be necessary for the patient to wear a bandage, until sufficient time has elapsed for the ligaments to be restored to their natural condition.

2. Where the disease has terminated in the absorption of the cartilages and ankylosis, it is to be borne in mind that the union of the bones is only by soft substance in the first instance, and to prevent any injury accruing from accidental violence, leather splints should be worn until there is reason to believe that the bony union is complete. While the process of union is going on, it is important that the surgeon should endeavour to place the limb in that position which will be most convenient to the patient afterwards. I have adverted to this subject before, but it is a matter of so much importance that no excuse is necessary for repeating the observation. A fore-arm in a state of permanent flexion is still a very useful limb, while it is comparatively useless if it be permanently extended. A leg bent at an acute, or even

at a right angle to the thigh, is an actual incumbrance, and I have known a patient to submit to amputation on this account; whereas if the leg be ankylosed in the same line with the thigh, the inconvenience is really trifling. I was consulted at the same time by two individuals, in each of whom there was ankylosis of the hip joint. In one of them the femur was fixed at a right angle to the pelvis, while in the other it was fixed in the line of the trunk. The latter walked with a moderate limp and suffered little inconvenience, while the former could not walk, except with crutches, and complained that his leg and thigh were always in his way.

3. When the joint is left not ankylosed, but limited, as to motion, in consequence of a thickened state of the synovial membrane, with or without adhesions in the neighbourhood, with a view to the restoration of its mobility, friction may be employed, as I believe, with some advantage. For this purpose it is best to employ a professional rubber, the friction being made with the hand, having in it some powdered starch, for half an hour or an hour, or two or three hours daily according to circumstances; or shampooing, which is another mode of friction, may be had recourse to, combined with the vapour bath. All kinds of friction, however, are to be used with caution, as if resorted to at a too early period, or carried to a great extent, they will not fail to cause a recurrence of inflammation. Nor are these methods of expediting the cure to be regarded as actually necessary. In fact, the mere exercise of the joint for the common purposes of life, answers the purpose of friction, and it is a question whether, in many instances, friction and shampooing have not obtained the credit which really belongs to a less artificial mode of treatment.

Friction may be used for another purpose, with perfect safety and with much advantage. Where a joint has been long diseased, the muscles of the limb become weak and wasted, from want of use. One of the first symptoms of the patient's amendment is, that he complains of weakness, which, while the disease was going

on, he had not discovered. Friction of the muscles has in some degree the same effect as exercise, causing more blood to flow into them, and increasing their bulk and power of action, and thus enabling the patient to regain the use of the limb sooner than he would regain it otherwise.

I have already described what I believed to be the proper mode of treatment to be pursued, where acute inflammation of the synovial membrane has proceeded rapidly to suppuration. In the majority of such cases, with due attention on the part of both the surgeon and the patient, the limb may be preserved. It is far otherwise when an abscess in a joint is the result of a long-continued and neglected chronic inflammation. Here, not only all the soft parts are in a state of extensive disorganisation, but the disease has affected to a greater or less extent the cancellous structure of the bones. I do not say that a joint under such circumstances, by means of support from splints, and attention to the general health, can never be preserved, but I believe that the cases of recovery form a rare exception to the general rule; and, that for the most part, the principal thing for the surgeon to consider is, whether there be or be not any objection, on account of the state of the patient's general health, or otherwise, to the removal of the limb by amputation.

CHAPTER II.

ULCERATION OF THE SYNOVIAL MEMBRANE.

The three following cases present some peculiarities, which lead me to regard them not only as worthy of being recorded, but as deserving a separate place in this volume. The most remarkable circumstances belonging to them are the occurrence of ulceration of the synovial membrane, at so early a period that it is a question whether this was not the primary disease; and the very urgent symptoms which arose from the sympathy of the general system with the local malady.

Case XII.

A young lady, nine years of age, being at play, on January 1, 1808, fell and wrenched her hip. She experienced so little uneasiness, that she walked out on that day as usual. In the evening she went to a dance but while there was seized with a rigour; was carried home and put to bed. Next morning she was much indisposed, and complained of pain in the thigh and knee. On the following day she had pain in the hip, and was very feverish. These symptoms continued; she became delirious; and she died at the end of a week from the time of the accident.

On inspecting the body on the following day, the viscera of the thorax and abdomen were found in a perfectly healthy state. The hip-joint, on the side of the injury, contained about half an ounce of dark-coloured pus; and the synovial membrane, where it was reflected over the neck of the femur, was destroyed by ulceration, for about the extent of a shilling.

Case XIII.

A middle-aged man, who had met with a contusion of one shoulder, was admitted into St. George's Hospital in the winter of 1812. He complained of pain and tenderness of the shoulder, and very slight degree of swelling was observable: but his principal disease was a fever resembling typhus in its character, of which he died in a few days after his admission.

On inspecting the body, about half an ounce of thin pus was found in the shoulder-joint. The synovial membrane bore marks of general inflammation; and in one spot, where it was reflected over the neck of the os brachii, it was destroyed by ulceration for about the extent of a sixpence.

Case XIV.

Master F., about ten years of age, awoke on the morning of December 18, 1839, complaining of pain in the region of one hip. By the middle of the day the pain had increased, so that he had great difficulty in moving the limb. He was directed by his medical attendant, Mr. Lucas, to remain in the recumbent posture, and to take some aperient medicine. He had a sleepless night, and on the following morning his pulse was about 100 in a minute; his countenance was flushed; and he experienced intense pain, referred to the *os ilium* and the groin. Mr. Lucas prescribed the application of leeches, pills of calomel and opium, and a saline medicine, with antimonial wine. In the course of the two following days the leeches were repeated. On December 23, by Mr. Lucas's desire, I was consulted. At this time the pain was intense, aggravated on any attempt to move the limb; and there was great general disturbance of the system. I recommended that the same plan of treatment should be continued. The symptoms, however, were not relieved. I saw him again on December 28, when there were symptoms similar to those which indicate an effusion of fluid in the ventricles of the brain; that is, moaning, stupor, and dilated pupils. On the evening of that day he died.

The body was examined by Mr. Lucas, to whom I am indebted for the following account of the morbid appearances:—

The cavity of the hip-joint was filled with pus, and before it was opened into, pus might be seen escaping from it, apparently through small ulcerated openings in the capsular ligament and synovial membrane.

The internal surface of the synovial membrane was ulcerated in several places. The internal or round ligament was destroyed by ulceration at the extremity connected with the acetabulum, while that part of it which was connected with the head of the femur remained entire.

The cartilage at the upper part of the acetabulum was destroyed by ulceration, but only to a small extent. There were some small superficial ulcerations of the cartilage covering the head of the femur, giving it an uneven surface, but not penetrating through its substance.

CHAPTER III.

ON CASES IN WHICH THE SYNOVIAL MEMBRANE HAS UNDERGONE A MORBID CHANGE OF STRUCTURE.

In one of the cases formerly described, it has been stated that 'the synovial membrane had completely lost its natural structure, being highly vascular, and much thickened, so that it projected into the articular cavity covering the margin of the cartilaginous surface.'

Such alterations in the condition of the synovial membrane are not very uncommon in cases of chronic inflammation, neglected and protracted, as it often is, for a series of years.

Case XV.

In a diseased knee, which was sent to me for examination by my friend the late Mr. Horn, surgeon to the Newcastle Infirmary, I found, in the cavity of the joint, about four ounces of a pale yellow fluid, having flakes of coagulated lymph floating in it. The synovial membrane, where it formed the loose folds, extending from one bone to the other; where it was reflected over the bones themselves, the crucial ligaments, and the fatty substance of the joint, had completely lost its natural appearance. It was converted into a pulpy substance; in most parts about a quarter, but in some parts nearly half an inch, in thickness, of a light-brown colour, intersected by white membranous lines, and with red spots formed by small vessels injected with their own blood. The synovial membrane on the edge of the cartilaginous surfaces had undergone a similar change of structure, but only for a small extent. The semilunar cartilages were entire, but in a great

measure concealed by the pulpy substance projecting over them. The cartilages covering the bones, in a few places, were in a state of incipient ulceration.

Case XVI.

James Gould, sixty-five years of age, was admitted into St. George's Hospital in May 1834. One knee was swollen and stiff, admitting of scarcely any motion. The swelling was elastic. He complained of severe pain in the joint. Near the ligament of the patella was the orifice of a sinus, which discharged a very small quantity of pus. No clear history could be procured of the disease in its earliest stage, except that the joint had been the seat of repeated attacks of inflammation of the synovial membrane.

The limb was amputated on May 23.

On dissection, the ligaments, bones, cartilages, and the layer of the synovial membrane reflected over the cartilages, were found to be in a natural state; but the synovial membrane in other parts was preternaturally vascular, and much thickened, having undergone the same morbid change as in the case last mentioned.

In other cases the synovial membrane undergoes changes which are still more remarkable. Not only does it, as in the preceding cases, lose altogether its membranous character, but vascular fringes project from it into the cavity of the joint, which, in a more advanced stage of the disease, become converted into a number of membranous processes, containing a fatty matter, and a good deal resembling, not only in appearance but in structure, the *appendices epiploicæ* of the great intestine.

Case XVII.

George Ainsworth was admitted into St. George's Hospital under the care of Mr. Keate, on June 8, 1840, having laboured under what was considered to be a rheumatic disease of one knee during the preceding eighteen months.

The joint was painful and much enlarged, and the size of it was not much reduced under the use of the remedies employed.

On September 16th he left the hospital of his own accord, but shortly afterwards he was readmitted under the care of Dr. Hope, on account of a pulmonary disease, of which he died.

On examining the body, numerous masses of effused blood, from the size of a pea to that of a hazel-nut, were found in both lungs, the intermediate tissues being apparently in a healthy state.

The synovial membrane of the diseased knee was connected into a thick mass of organised substance, which presented a peculiar flocculent appearance on its inner surface. The parts are preserved in the Museum of St. George's Hospital.

I shall hereafter describe the case of a woman, who died in St. George's Hospital of another disease, having, during a very long period of time, laboured under what was considered as a chronic rheumatic affection of various joints, but especially of the knees; and in whom, the synovial membranes of these joints, besides being much thickened and preternaturally vascular, presented on their inner surface the appearance of a great number of excrescences, such as I have already mentioned as resembling the *appendices epiploicæ* of the great intestine, smooth and membranous externally, and internally composed of condensed cellular membrane and fat.

That this morbid condition of the synovial membrane was to be regarded as the effect of long-continued inflammation, there can be no doubt. In the Museum of St. George's Hospital there is a preparation of a knee-joint, the synovial membrane of which is affected in the same manner, the only difference being that the excrescences are more numerous and more distinctly marked. I conclude that the disease had the same origin; but I purchased the preparation at the sale of the late Mr. Heaviside's museum; and nothing is known of the history of the case.

Although in the great majority of instances in which the

synovial membrane of a joint has undergone a morbid alteration of structure, that alteration has been the consequence of long-continued and neglected inflammation, we are not, therefore, justified in the conclusion, that in all cases in which the synovial membrane is thus affected, the disease is to be traced to the same source. At all events, there is no reason why in this, as in other parts of the body, a change of this kind should not take place from other causes and independently of any antecedent inflammatory action. The following cases may throw some light on this inquiry, which is one of considerable interest both to the pathologist and to the practical surgeon.

Case XVIII.

Martha Manners, twenty-six years of age, was admitted into St. George's Hospital on March 6, 1813, on account of a disease in her right knee.

She said that in June, 1811, she first observed the joint to be swollen and stiff; and from this time the swelling and stiffness increased; but, in the first instance, by very slow degrees. About Michaelmas 1812 she caught cold, and the swelling increased more rapidly; but it was not attended with any considerable degree of pain.

At the time of her admission into the hospital, the right knee measured about two inches in circumference more than the left. The swelling was elastic; prominent at the upper and lower part of the joint, not having the form of the articulating ends of the bones. The joint admitted of motion, but the leg could not be completely bent or extended on the thigh.

Various remedies were employed without the smallest benefit.

The stiffness of the joint increased. About the middle of May, she began to experience considerable pain; and soon afterwards an abscess presented itself by the side of the ligament of the patella, which was opened on June 15. The orifice made by the lancet healed in a few days; but she continued to suffer severe

pain; her health became much affected, and on August 6, the limb was removed by amputation.

On examining the joint, about an ounce of thick pus was found in its cavity. The ligaments were in a natural state. The synovial membrane, where it extended from one bone to the other, was converted into a brown pulpy soft mass, of considerable thickness, intersected by membranous lines. The whole of the thin layer of the synovial membrane covering the cartilages had undergone a similar change, the only difference being that here it was of much less thickness than elsewhere.* The cartilages had begun to ulcerate in a few spots, but the ulceration had made so little progress, that it might have been overlooked by a careless observer.

Case XIX.

John Dillmore, thirteen years of age, was admitted into St. George's Hospital in the summer of 1812, on account of a disease of one knee.

The joint was slightly swollen, and stiff, so as to admit of only a limited degree of motion. He was free from pain. The swelling was elastic, and there was no perceptible fluctuation of fluid. These symptoms had been coming on gradually for two years previous to his admission. At this time he remained in the hospital for upwards of three months, and a great number of remedies, which it is unnecessary to enumerate, were employed without the smallest advantage.

* As I stated formerly, Bichat has considered the membrane by which the cartilages are invested as a continuation of the synovial membrane. This view of the matter has been controverted by some modern anatomists. The dispute is in great measure verbal, as no one doubts that there is a thin membrane expanded over the cartilages, which begins at the margin, where the synovial membrane terminates. In the case above described, as well as in that which follows, the membrane covering the cartilage partook of the disease which affected the membrane lining the ligaments, and passing from one bone to the other; and this fact seems to justify the application of the same name to both structures. On this subject the reader may refer to Mr. Toynbee's Paper in the third Number of the London Journal of Medicine, March 1849.

On January 26, 1814, he was readmitted into the hospital. The affected knee was now two inches and a half in circumference more than the other. The swelling was elastic; it extended up the anterior and lower part of the thigh, as in cases of inflamed synovial membrane, but its form was less regular, being more prominent, and extending higher up on the outside, than on the inside of the limb. The leg was kept in the half-bent position, and was perfectly immovable on the thigh. The patient was subject to occasional attacks of violent pain. He said that the swelling had gradually increased from the period of his quitting the hospital in 1812, but that he had not been subject to any severe pain until about six weeks previous to his readmission. On January 31 the limb was amputated.

On examining the diseased joint, the synovial membrane was found converted into a pulpy substance of a light brown colour, with red spots, arising from vessels ramifying in it, injected with their own blood, and it was intersected by very numerous membranous lines. On the outside of the joint, the diseased membrane was in some places nearly an inch in thickness. The membrane covering the cartilages in some parts was in a natural state; in other parts, it had undergone the same morbid change of structure as elsewhere. The cartilages were ulcerated in spots. There was about half an ounce of pus in the cavity of the joint, and there were two or three abscesses in the substance of the synovial membrane, not communicating with the joint, containing in all about the same quantity of purulent matter.

Case XX.

William Hine, twenty-three years of age, was admitted into St. George's Hospital on December 12, 1814, on account of a disease in one of his knees. He said that, in the summer of 1812, he first observed a slight degree of stiffness and swelling of the joint, unattended by pain. At first the swelling was confined to the inside, but it gradually extended itself over the whole circumference of the joint. The stiffness and swelling slowly,

but uniformly increased, and about the end of the year 1813, he began to experience considerable pain.

At the time of his admission, the knee was much swollen; the swelling was irregular, and most prominent on the inside; it was soft and elastic, without the fluctuation of fluid. The patient complained of constant, deep-seated, gnawing pain, which disturbed his sleep. He had a slight degree of hectic fever. On December 16, the limb was amputated.

On dissecting the amputated joint, the synovial membrane was found to have undergone the same morbid alteration of structure as in the last case. The cartilages were slightly ulcerated in a few spots.

I have notes of some other cases which do not essentially differ from those which have been just related. It is to be observed, that in the commencement there was neither pain, nor tenderness, nor other signs of inflammation present; that the enlargement of the joint began almost imperceptibly, and that it increased steadily and gradually; that until the disease had reached a very advanced stage, stiffness of the joint and swelling were its characteristic symptoms, with little or no pain, even when the limb was moved; and all these circumstances seem to warrant the conclusion that the disease was no more inflammatory in its orgin than morbid alterations of structure, and morbid growths generally, are in other organs. Nor is this opinion contradicted by the fact of inflammation, with abscess and ulceration of the neighbouring textures, occurring ultimately, this being analogous to what happens in cases of tubercles of the lungs, schirrus of the breast, and even in so simple and innocent a disease as the common adipose tumour.

It is evident from the history of cases in which a part of the living body has assumed a new and morbid structure, that this

alteration seldom takes place except by slow degrees; and it would add much to the interest and utility of researches in morbid anatomy if it were more frequently attempted to ascertain, what is the first change in the organisation of the affected part which such a disease produces, and from thence to trace the gradual progress of the other changes which take place, until the destruction of the natural organisation is completed. Whether the following case is to be considered as of the same kind as those last described, but in an earlier stage of the disease, cannot at present be determined: at all events, it seems worthy of being recorded; and I venture to introduce it in this place, in the expectation that it may at any rate be of some service in assisting the labours of future inquirers.

Case XXI.

—— Belton, a boy eleven years of age, was admitted into St. George's Hospital, in August, 1810, on account of a disease in one knee.

There was but little pain in the joint: it was slightly enlarged, admitted of some motion, but not of complete flexion and extension. His parents said that the disease had begun about a year and a half before his admission into the hospital; that it had increased very slowly; and that he had never suffered from it any serious distress. Various remedies were employed without benefit; and in a short time his friends took him out of the hospital. A few weeks afterwards he died, in consequence of an accumulation of water in the ventricles of the brain.

Having the opportunity of examining the body, I found that the synovial membrane of the affected knee externally had its natural appearance. Internally it was lined by a straw-coloured gelatinous substance, so intimately adhering to it, that it could not be detached, except by an artificial separation. The synovial membrane was encrusted in this manner everywhere except on the cartilaginous surfaces. The gelatinous substance in general appeared to be about one-eighth of an inch in thickness, but in

some parts near the margin of the cartilage it was much thicker, so as to project considerably into the cavity of the joint. In a few places, towards the edge of the articulating surfaces, the cartilage had begun to ulcerate. In some of these it was entirely absorbed, so that the bone was exposed; but for the most part there was only an irregular ulceration on the surface, the remaining portion of the cartilage being entire, and retaining its natural adhesion to the bone.

The synovial membrane itself bore no marks of inflammation. In the substance with which it was lined some vessels were observed ramifying, injected with their own blood; but these were few in number, and only in certain parts. This substance differed from the coagulated lymph which is found on the surface of an inflamed membrane; and we may presume, considering the circumstances, that it was the result, not of inflammation, but of some other morbid action.

Section II.

Diagnosis and Treatment of these Cases.

When the synovial member of a joint has been the seat of long-continued and neglected inflammation, we may conclude that it has become in a greater or less degree altered in structure; but it is only in the more advanced stage of such disorganisation that its existence can be distinctly recognised. It is then indicated by the swelling being of a less regular shape than formerly (being more prominent in some parts, less so in others), and by its being formed chiefly of an elastic solid substance, under which the fluctuation of fluid is for the most part only just perceptible.

The analogy of what happens in the case of the inflamed and granulated *conjunctiva* consequent on conjunctival ophthalmia, seems to justify the opinion that, when the change in its condition exists only in a limited degree, the synovial membrane may, under a proper mode of treatment, persevered in for a considerable

length of time, be restored to a healthy state. But it would be unreasonable to expect this favourable result in the more advanced stage of the disease. Under these circumstances, the questions will arise—Is the joint altogether in a hopeless condition? Can the limb be preserved; or must the patient sacrifice it in order that he may save his life?

If the local symptoms, or the hectic state of the general system, indicate that the diseased state of the synovial membrane is complicated with abscess in the joint, the removal of the limb by amputation is, in the very great majority of cases, the most prudent and safest course. But if this complication does not exist, I am inclined to believe that the limb, though not the joint, may often be preserved. In an ankylosed joint, the synovial membrane gradually wastes away, and at last wholly disappears. Under the circumstances which have been just described, let the bones of which the joint is composed be kept in a state of complete and absolute repose, by means of well-made and convenient splints, and let this system be continued until ankylosis has taken place. By degrees, the synovial membrane will become less tumid; and at last, the joint being reduced to even less than its natural size, we may presume that it has been altogether absorbed. I am much mistaken if I have not known this actually to happen. But such a result is not to be obtained without care and perseverance on the part of the surgeon and his patient, and confidence on the part of the patient's friends, whose very natural impatience forms one of the principal difficulties in the way of a cure of all the more tedious and obscure forms of curable disease.

I have already adverted to the principal circumstances on which our diagnosis is to be founded in those cases in which a morbid alteration in the structure of the synovial membrane, bearing a considerable resemblance to that which is the consequence of inflammation, takes place without inflammation having preceded it. They may be thus briefly recapitulated:—

1. A sense of stiffness, and a tumefaction beginning, almost imperceptibly, and then slowly and gradually increasing.

2. An absence of pain, even on the joint being moved, and of the other signs of inflammation, until the most advanced stage of the disease, when the cartilages begin to ulcerate, and abscesses form, either in the joint itself, or in the substance of the swollen membrane.

3. Ultimately, a very considerable enlargement of the joint, generally of an irregular shape, formed by a mass of solid but elastic substance, without any distinct fluctuation of fluid.

This disease evidently is one of the more simple kinds of morbid growth. It is altogether local, contaminating neither the lymphatic glands nor the general system. After having been removed by amputation, I have no reason to believe that it is liable to reappear, either in the limb itself or elsewhere.

I formerly had been led to regard the disease as one which does not admit of a cure; and I still see no reason to doubt the correctness of this opinion respecting it in its more advanced stage. My later experience, however, leads me to think more favourably of it, if it be attended to at an earlier period. The following history will sufficiently explain the treatment which may be had recourse to with advantage.

Case XXII.

Mr. W., 18 years of age, consulted me on the 1st of April, 1835.

The right knee was much enlarged: it admitted of very limited motion. The swelling was soft and elastic, more prominent in some parts than in others. The patient did not complain, except of a slight aching occasionally, produced by exercise. He said that the swelling and stiffness began almost imperceptibly five years ago, and had increased uniformly and gradually up to the time of my being consulted. The general health was unimpaired.

The joint was supported by alternate layers of calico bandage and adhesive plaster, so as to make an uniform and moderate pressure on it, and at the same time limit its motion. In addition to the local treatment, a course of sarsaparilla was prescribed, with

small doses of the bichloride of mercury. This medicine was taken for about eight weeks.

On the 29th of February, 1836, I prescribed two grains and a half of the iodide of potassium, to be taken three times daily.

Under this plan of treatment the knee became much reduced in size. On the 23rd of April following, a pair of leathern splints, supported by a bandage, was substituted for the plaster and bandage which had been applied previously.

I saw him for the last time on the 24th of April 1838. The same local treatment had been continued under the superintendence of his provincial surgeon. The joint was now scarcely larger than the other: it was quite stiff. He was free from pain, except a slight aching occasionally, and might be considered as well, though it still seems desirable that he should abstain from violent exercise.

CHAPTER IV.

SCROFULOUS DISEASE OF THE JOINTS, HAVING ITS ORIGIN IN THE CANCELLOUS STRUCTURE OF THE BONES.

Section I.

Pathological Observations.

The term Scrofula is often employed without much precision; and indeed it is not always easy to determine to what symptoms it may or may not be properly applied. The more correct view of the subject seems to be, that it indicates, not any specific disease, but rather a certain morbid state of the general system, under which various local diseases (many of them having no manifest resemblance to each other) may have their origin. Some individuals are born with a disposition to suffer from this class of diseases, often deriving it by inheritance from their parents; but there is no one, however strong his natural constitution may have been, in whom the same diseases may not take place when in a state of debility, consequent on insufficient nourishment, measles, scarlet fever, or any other depressing illness, or exposure to other hardships.

Many practitioners are accustomed to regard nearly all the chronic diseases of joints as scrofulous; but I hold this to be altogether a mistake. Persons of scrofulous habit are not more liable than others to the diseases which form the subjects of the preceding chapters. There is, however, another malady affecting the joints, having all the characters of scrofula, generally occurring in persons who have a scrofulous appearance, and often preceded by, or combined with, other scrofulous symptoms.

In this disease, which according to my experience is next in order of frequency to the affections of the synovial membrane, the cancellous structure of the bones is the part primarily affected; ulceration of the cartilages covering their articulating surfaces taking place afterwards. The cartilages being ulcerated, the subsequent progress of the disease is in many respects the same as where the ulceration takes place under other circumstances.

Case XXIII.

Thomas Scales, aged 18, having a scrofulous appearance, was admitted into St. George's Hospital on the 18th of October, 1815.

He complained of pain, which he referred to the inside of one foot. The pain was constant but slight, and not sufficient to prevent his walking as usual. There was very little, if any, tumefaction, and the parts were not tender to the touch. He was also in a general ill state of health; there were symptoms of derangement of the functions of the liver, and the urine was turbid, depositing a quantity of sediment, which stained the vessel that contained it of a pink colour. He was heavy and stupid, and scarcely able to give any consistent account of his ailments. There were some small ulcerations at the edges of his eyelids.

While he was under a course of remedies for these complaints, he was seized, in the beginning of February 1816, with a continued fever, of which he died on the 1st of March.

On dissection, the foot, which had been the seat of the pain, was particularly examined. The bones of the tarsus and metatarsus, were found to contain an unusually small quantity of earthy matter; so that they were preternaturally soft, and admitted of being cut in any direction with a scalpel, without turning its edge. The cut surfaces of these bones were of a deep red colour, in consequence of increased vascularity; and vessels injected with their own blood could be distinctly traced extending from the bones into the cartilages covering them, and rendering the latter, in a few spots, of a red colour. The cartilage covering the inter-

nal cuneiform bone, where it forms the joint with the metatarsal bone of the great toe, was ulcerated to a small extent. The ulceration had begun on that side of the cartilage which was connected to the bone; the surface towards the joint remaining entire. The bones of the tarsus were more diseased than those of the metatarsus; and those on the inside of the tarsus were affected in a greater degree than those on the outside. The bones of the other foot were affected in the same manner, but in a much less degree. The articulating extremities of some other bones were examined, and were found nearly in a natural condition.

Case XXIV.

December 21st, 1814. In a boy, apparently about 10 years of age, whose body I had the opportunity of examining after death, I observed the following appearances:—

Both elbows were slightly swollen. On the fore-part of the right arm, immediately above the elbow, there was the orifice of a sinus, which extended downwards obliquely into the cancellous structure of the bone, where it terminated, without communicating with the cavity of the joint. The cancellous structure of the articulating extremities of the humerus, radius, and ulna was so soft, that it might be crushed by a very slight degree of force when squeezed between the fingers; it was of a dark red colour, preternaturally vascular; and there was a reddish fluid, mixed with medulla, in the cancelli. The cartilages covering the radius and ulna were in a natural state; that belonging to the humerus was ulcerated in a few spots on the surface towards the bone, while on the surface towards the cavity of the joint it was entire. There were no morbid appearances of the ligaments or synovial membrane.

The bones of the left elbow were in a similar state of disease; the cartilages were entirely destroyed by ulceration, and carious surfaces of bone were exposed. A small portion of dead bone had exfoliated into the cavity of the joint, where it lay surrounded by matter. The synovial membrane and ligaments were extensively

destroyed, and there were several sinuses communicating with the joint and opening externally.

On examining the right knee, which externally had not the slightest marks of disease, and admitted of perfect motion, the cancellous structure of all the bones which enter into its composition was found in the same morbid condition with that of the bones of the elbows, being preternaturally red and vascular, with a much less proportion than is usual of earthy matter, so that it admitted of being crushed by a very slight force. In the interior of the lower extremity of the femur, between the two condyles, there was one part where the earthy matter seemed to have entirely disappeared, and there was in consequence an irregular space, in which there was little else than medulla and a reddish fluid mixed together; near this part the cartilage had only a very slight adhesion to the bone, and ulceration had begun on its inner surface.

In several other joints which were examined, there were marks of the same disease, but in a less advanced stage.

Case XXV.

John King, 26 years of age, having blue eyes, thick lips, and a florid complexion, was admitted into St. George's Hospital on the 1st of June, 1811, on account of a disease in his right ankle and foot. I received the following account of his case, partly from himself, and partly from a medical practitioner, who was in the habit of seeing him before he came into the hospital.

About the end of May 1810, he wrenched his foot. The instep and ankle became swollen and painful, but in a few days these symptoms subsided. During the summer he experienced slight pain and weakness of these parts, whenever he took more than his usual quantity of exercise. In October a slight tumefaction was observed on each side of the ankle, and the pain was more severe, but still not sufficient to prevent his going about his usual occupations. About the middle of December the pain became more violent, and he was confined to the house for a fortnight; after

which the pain abated, so that he was able to go about with the assistance of a crutch.

In March 1811 an abscess burst on the outside of the foot. The formation of the abscess was not attended with any considerable degree of pain.

He formerly had been supposed to labour under incipient *phthisis pulmonalis*; but from the time of the disease having begun in his foot, he had suffered no inconvenience from the complaint in his lungs.

At the period of his admission into the hospital, there was a diffused œdematous swelling of the soft parts over the whole foot and ankle. On the outside there were the orifices of three or four sinuses, which had burst at different periods. He had very little pain even on motion or pressure. Soon after his admission, another abscess broke on the inside of the heel.

On the 11th of July the leg was amputated.

On examining the foot, the cells of the cellular membrane were found distended with serum and coagulated lymph.

All the bones had undergone a morbid change, similar to what was observed in the last case, except that they were even softer and more vascular.

The cartilages of the ankle were completely destroyed by ulceration, and the exposed surfaces of bone were in a state of caries.

The cartilages of the tarsus were entire, but, in some places, of a red colour; and this was found to arise from vessels containing red blood extending into them from the bone. The ligaments and synovial membranes of the tarsal joints were in a natural state, as were also those of the ankle, except where they had been destroyed by the abscesses.

Case XXVI.

This patient was a soldier in the Coldstream regiment of Guards. I once had an opportunity of seeing him before amputation was performed; and, through the kindness of the medical officers of the regiment, I was favoured with the previous history of the

complaint, and with the opportunity of examining the amputated joint.

WilliamMiles, 20 years of age, of a delicate complexion, with red hair and dilated pupils, was attacked with a slight pain and swelling of the left knee about the middle of January 1808. On keeping quiet for a few days, the swelling subsided; but it returned about the end of March, though still attended with very little pain.

He was received into the hospital of the battalion at Chatham, and on the 9th of June following he was sent to the regimental hospital in London.

At this time the diseased knee measured in circumference three inches more than the other. Fluid was felt external to the joint, and in the cavity of the joint itself. The leg was kept extended, and all attempts to bend it gave considerable pain; but otherwise the pain which he endured was trifling, amounting only to a slight degree of uneasiness, deep-seated in the joint. On the 8th of July, an abscess burst near the inner edge of the patella, and discharged about eight ounces of thin pus. On the 27th of July, the limb was amputated.

On examining the knee, the articulating extremities of the tibia and fibula were found to be so soft, that they were readily cut by a common knife: they contained much less earthy matter than is usual, and their cancelli were filled by a yellow cheesy substance.

The cartilage covering the head of the tibia was destroyed by ulceration in a few spots at the margin; that of the femur was eroded for a very small extent behind the crucial ligaments. The patella and the cartilage covering it were in a natural state. Coagulated lymph having a gelatinous appearance had been effused into the cellular texture, on the outside of the synovial membrane. Pus was found external to the joint, and in the joint itself.

Case XXVII.

Charles Miller, 20 years of age, having blue eyes, light hair, and a fair complexion, was admitted into St. George's Hospital in April 1808, on account of a disease of one foot.

The whole foot was swollen and œdematous, with two fistulous sinuses, one on the inside and the other on the outside, through which a small quantity of scrofulous matter was discharged. A probe having been introduced into either of these sinuses, some exposed surfaces of bone might be distinguished.

On the 16th of May, the limb was amputated below the knee.

On examining the amputated foot, the muscles were found pale and wasted from want of use, and the cellular membrane was distended with coagulated lymph.

The extremities of the tibia and fibula, all the bones of the tarsus, and the extremities of the bones of the metatarsus, contained much less earthy matter than is usual. They were so soft, that they might be cut with a scalpel without the edge of it being turned. They were preternaturally red and vascular, and a yellow cheesy substance was deposited in the cancelli. The cartilage at the base of the fifth metatarsal bone was destroyed by ulceration. Those at the bases of the three middle metatarsal bones were also destroyed, and the exposed surfaces of bone were dead and undergoing the process of exfoliation. The cartilages of all the other bones were in a natural state. Pus and coagulated lymph had been effused in the neighbourhood of the dead and carious bones, and the sinuses communicated with them. The synovial membrane and ligaments were in a natural state, except where destroyed by ulceration.

Case XXVIII.

Ellen M'Millan, 8 years of age, was admitted into St. George's Hospital on the 6th of March, 1833.

She complained of pain in the right hip, extending down the thigh, and much increased by motion, or by pressing the articulating surfaces against each other. The foot was everted. The limb was of its natural length. She had been observed to limp in walking about six weeks ago, since which the symptoms had progressively increased.

In the beginning of April, while under treatment for the disease

of the hip, she became affected with other symptoms, indicating the existence of disease in the brain; under which she sank and died on the 6th of that month.

On examining the body, a scrofulous tubercle was discovered in the lower part of the right hemisphere of the cerebrum, and the vessels of the brain generally were found to be turgid with blood.

In the right hip, the cartilage of the head of the femur, in the neighbourhood of the attachment of the round ligament, was found to have been destroyed by ulceration, and of the round ligament itself scarcely any vestige remained. The cartilage of the acetabulum was also ulcerated to some extent at the lower part. The bone of the pelvis, where it forms the acetabulum, and the head and neck of the femur were of a soft consistence, so that they could be divided by a knife; and there was a considerable deposit of yellow substance in the cancellous structure of the latter.

On examining the bones of the left hip, they were found to be affected in the same manner as those of the right hip, but they were in a less advanced stage of the disease.

The cartilage of the head of the left femur was detached with unusual facility from the bone below, the surface of the latter presenting a highly vascular appearance; and in two spots the layer of the cartilage towards the bone was destroyed by ulceration, while that towards the cavity of the joint remained entire. The space thus formed between the cartilage and the bone was occupied by a vascular substance having the appearance of granulations.

Case XXIX.

A girl, 15 years of age, was admitted into St. George's Hospital, in the winter of 1809, labouring under symptoms of disease of one hip, as well as of one elbow. After remaining some months in the hospital, she left it of her own accord in the beginning of August. In the following October she was readmitted, with the disease both of the hip and elbow much advanced. There was a large abscess in the thigh; her general health was much impaired,

and she sank and died in less than six weeks after her readmission.

On dissection, the abscess in the thigh was found communicating with the cavity of the hip-joint, through an ulcerated opening of the capsular ligament, and synovial membrane. The cartilages of the hip had entirely disappeared; the bones were carious; the acetabulum had been rendered deeper and wider, and the head of the femur smaller than natural. The capsular ligament and synovial membrane were thickened, and a soft organised mass, similar to the substance of adhesions, was found adhering to the neck of the femur. The cancellous structure of the bones was softer than natural, so that it might be cut with a scalpel, or crushed between the fingers; and the appearance of it in other respects corresponded to that of the diseased bones in the cases which have been just related.

The disease of the elbow was similar to that of the hip-joint; but it had made less progress. The ligaments and synovial membrane of the elbow were nearly in a natural state, and some thin portions of cartilage still remained lying on the surface of the carious bone, but having little or no ahesion to it.

Case XXX.

Margaret Mc Quinie, 5 years of age, was admitted into St. George's Hospital, March 27, 1839.

There was considerable enlargement of the hip-joint of the right side; and in some parts the fluctuation of fluid was distinctly perceptible. The thigh was bent forward on the pelvis, the lower extremity of it resting on the limb of the other side.

Every attempt to move the limb, the pressure of the head of the femur against the acetabulum, and pressure in the groin, caused considerable pain. The child seemed to suffer but little pain otherwise.

Soon after her admission, an abscess in the neighbourhood of the hip was opened, and a large quantity of pus was discharged.

The general health was a good deal affected, and it gradually grew

worse. The local suffering also increased. There were painful startings of the limb at night. The feet became œdematous; and the child gradually sank, and she died on the 28th of November.

On dissection, the thigh was found considerably bent on the pelvis. There were extensive abscesses in the cellular membrane in the immediate vicinity of the joint, but there was no pus in the joint itself. The synovial membrane was in a state of great vascularity, especially at the lower part of the joint. The cartilage covering the head of the femur had been partially absorbed. In some parts it was so thin that the dark surface of the bone was plainly to be distinguished through it. In other parts it was ulcerated in spots, in such a manner as to present an appearance as if it had been worm-eaten. In no one part was the absorption of it so complete as to expose the subjacent surface of bone.

The cartilage lining the acetabulum had been absorbed to a much greater extent. At the lower and inner part it had wholly disappeared, this part of the joint being occupied by a dense substance extending from the bone to the synovial membrane lining the capsular ligament.

The head of the femur rested on the margin of the acetabulum, immediately behind the joint. The capsular ligament was entire, but considerably dilated, having accommodated itself to the displacement of the head of the femur.

The bones were highly vascular, being of a dark red colour, and contained so little earthy matter as to be readily cut with a scalpel.

The preceding cases sufficiently illustrate the nature and progress of the disease, as far as these can be disclosed to us by dissection.

The morbid action seems to have its origin in the cancellous structure of the bones, which in the first instance is preternaturally vascular, with a less than usual proportion of the phosphate of lime in its composition, there being at the same time a deposit of fluid, apparently serum, in the cancelli.

As the disease advances, the cancelli are found to contain a yellow substance, which is sometimes collected in large masses

resembling the tubercular deposits found in other parts of the body. The vascularity of the articulating extremities of the bones becomes diminished, so that at last they are even considerably less vascular than healthy bones. Occasionally portions of bone lose their vitality, and are separated by exfoliation into the articular cavity. This last result is more frequently observed in the joints of the carpus and tarsus than in any others.

From the diseased bone, vessels may sometimes be traced, carrying red blood, and extending into the substance of the cartilage. The adhesion of the cartilage to the bone is less intimate than under natural circumstances, and sometimes it may be completely peeled off, the surface of bone thus exposed being of a deep red colour from excessive vascularity.

The cartilage afterwards ulcerates in spots, the ulceration usually beginning on the surface towards the bone; the interval between the bone and the cartilage produced by the ulcerative process being filled up with a highly vascular lymph.

The ulceration of the cartilage usually proceeds slowly. Then the bone itself becomes carious, and ultimately it becomes absorbed to a great extent. In this stage of the disease, the bone is often of a dark colour, and offensive to the smell, in consequence of a purulent deposit becoming putrid in its cancelli.

As the bones become more extensively carious, inflammation takes place of the cellular membrane external to the joint. Serum, and afterwards coagulated lymph, is effused; and hence arises a puffy and elastic swelling in the early, and an œdematous swelling in the advanced, stage of the disease. Abscess having formed in the joint, it gradually makes its way through the ligaments and synovial membrane, and afterwards bursts externally, having caused the formation of numerous and circuitous sinuses in the neighbouring soft parts. It is remarkable that in one of the cases which have been related, although the disease of the bones and cartilage had made considerable progress, and there were extensive abscesses in the cellular membrane in the immediate vicinity of the joint, there was no pus in the joint itself. Such a case, however, must be regarded as a rare exception to the general rule.

In another case it has been stated that thin layers of cartilage were found lying on the surface of the bone, apparently unconnected with it. In some instances, in the advanced stage of the disease, we find nearly the whole of the cartilage forming an exfoliation, instead of being ulcerated.

This scrofulous affection attacks those bones, or portions of bones, which have a spongy texture, as the extremities of the cylindrical bones, and the bones of the carpus and tarsus; and the joints suffer merely from being contiguous to the original seat of the disease. Sometimes, however, the effect of this morbid condition may be traced even in the shaft of a cylindrical bone, so that we find the tibia or femur converted into a mere shell of earthy matter, enclosing a medullary canal of unusual magnitude.

In concluding this part of our enquiry, I ought not to omit to observe that a deficiency of phosphate of lime is not peculiar to the bones of those afflicted with scrofulous disease. It is the most essential change that takes place in cases of rachitis. There is, moreover, reason to believe that bones which, from any cause, have been during a long period of time left in a state of absolute rest, lose a portion of their earthy matter; and the same thing occurs not unfrequently in bones which have been long in a state of caries, whatever may have occasioned the caries in the first instance. It was probably from the joint operation of the two last-mentioned causes, that in a patient who died some time after of a compound fracture of the leg near the ankle, and in whom the bones at the seat of the injury were in a state of caries, I found the cancellous structure in the neighbourhood as deficient in its hard materials as it would have been in a truly scrofulous subject. But in all such cases the other changes which mark the existence of scrofulous disease are wanting; and this circumstance, combined with the previous history, is generally sufficient to enable the pathologist to distinguish these two classes of cases from each other.

Section II.

Symptoms and Diagnosis of this Disease.

The scrofulous affection of the joints occurs next in the order of frequency to inflammation of the synovial membrane. Unlike the latter, it is chiefly met with in young persons under the age of puberty; and it is comparatively rare after the middle period of life.

The morbid change in the cancellous structure of the bones which constitutes the beginning of this disease, may exist without producing pain, or any other manifest symptoms. It seems to be not until the commencement of ulceration of the cartilages that the patient experiences even the slightest inconvenience. Even then it often happens that, for a long time, the symptoms are not sufficiently urgent to cause any degree of anxiety to himself or his friends. There is probably no disease more insidious than this is in its origin; and at the same time there is none in which it is more important that the first access of it should not be overlooked.

The symptoms which are common to cases of this disease in different joints are—1. Pain, which is trifling in the first instance, but which often becomes very intense ultimately. 2. Swelling of the joint, at first from an effusion of lymph and serum into the neighbouring cellular texture, afterwards from abscess within the joint itself. 3. Stiffness of the joint, which, in cases of recovery after extensive destruction of the cartilages, terminates in complete anchylosis. 4. Painful startings of the limb, especially at night, which may be considered as being, in the majority of cases, indicative of the commencement of suppuration. 5. Abscesses presenting themselves externally in the neighbourhood of the diseased joint, with sinuses more or less complicated, according to the structure of the parts in which they are situated. 6. In many instances displacement of the bones, arising from the destruction of the ligaments of the affected joint, or of a partial absorption of

the bones themselves. 7. In protracted cases (where the patient's powers are exhausted by pain, long-continued purulent discharge, and want of air and exercise), perspirations at night and other symptoms of hectic fever.

In individuals of scrofulous habit one disease leads on to another. A child apparently healthy suffers from an attack of scarlet fever or measles, which leaves him in a weakened state. As a consequence of this, some one or more of his joints become the seat of scrofulous disease. If this be neglected, it ultimately reacts on the consitution, and when the patient has for some time laboured under hectic symptoms, the usual consequences of great prostration of the bodily powers ensue. Tuberculous matter is then deposited in the lungs or mesenteric glands, or there is a serous effusion into the ventricles of the brain; and it is, almost invariably, the establishment of a new disease in some one of the vital organs, and not the disease in the joint itself, that is the immediate cause of death in those cases which terminate unfavourably.

Having given this general history of the disease, I proceed to trace its progress in particular joints.

When the hip is affected, the first indication of the disease is generally nothing more than a slight limp in walking. I have in very many instances known a child to be thus affected for several months before the parents have suspected that there was any actual disease. At last it is observed that he occasionally puts his hand to his hip or knee, and complains of pain in one or the other of these joints, generally in the latter. Still even at this period his expressions of pain are often so trifling and so rare that they attract but little attention. From this time, however, the pain goes on increasing. If the limb be now examined, while the patient is in the recumbent posture, it is found that the pain is aggravated by pressing the head of the femur into the socket of the acetabulum, and also by certain motions of the joint, especially the abduction of the thigh from the other. It is also found that the motion generally is more limited than that of the other hip;

and especially that the femur does not admit of such complete flexion on the pelvis. Often at this period there is some enlargement of the lymphatic glands in the groin.

If the examination of the limb be made while the patient is in the erect posture, there is a manifest and very characteristic alteration in its appearance. He stands so as to throw the whole weight of the body on the other limb. On the affected side the thigh is slightly bent on the pelvis, as the leg is on the thigh, the foot being at the same time a little in advance of the other foot. The nates on the same side are wasted and flattened, and flaccid to the touch; they hang more loosely towards the lower edge, and have the appearance of being wider than natural, though they are not so in reality. The explanation of the altered appearance of the nates is, that the patient has avoided using the muscles of the hip, and that those at the posterior part, especially the *glutæus maximus*, are wasted.

As the disease advances there is a slight degree of swelling in the groin, independently of the glandular enlargement, accompanied with tenderness. The proximity of the groin to the hip-joint sufficiently explains the last-mentioned symptoms, but it is certain that in some cases there is actual tenderness of the knee also, to which the pain is only sympathetically referred. I have sometimes been led to believe, where the sympathetic pain of the knee was considerable, that there was even some degree of puffy swelling observable in it. These facts correspond to what may be observed in some other cases, where pain is referred to a sound part, in consequence of a sympathy existing between it and some other part which labours under disease. Thus a calculus passing down the ureter, if it be long retained there, may occasion not only pain but swelling and actual inflammation of the testicle.

The increase of pain which takes place in what may be called the second stage of the disease is very different in different cases; and it seems to depend very much on the treatment employed, being less intense where the patient has been confined to the recumbent posture at an early period, than where he has continued

to use the limb. In all cases, however, when suppuration has taken place, the pain is aggravated. There are sudden and painful startings of the limb, especially at night, and the patient, if a child, frequently is roused from his sleep under the influence of some frightful dream. The pulse is now increased in frequency, and this is generally accompanied with other symptoms of hectic fever. Ultimately the abscess formed within the joint makes its way into the parts external to it, and at last presents itself under the integuments, and this change is generally attended with some relief from suffering, especially as to the startings of the limb. Still every attempt to move the limb is productive of much pain, in consequence of the carious surface of the bones, now deprived of their cartilaginous coverings, being rubbed against each other. The abscess presents itself in various situations: on the inside of the thigh, below the groin, on the posterior part of the hip, under the glutæi muscles, and indeed in almost any part of the limb; and it is a longer or a shorter time in coming to the surface, according to the number of the muscles, or the thickness of the fascia over it.

In the early stage of the disease the limb has sometimes the appearance of being longer than that of the other side. This appearance is, however, altogether deceptive, and on a careful measurement being made with a tape from the anterior superior spinous process of the ilium to the patella or inner ankle, it is found that there is no elongation in reality. The pelvis is inclined laterally, so that it makes on the side of the disease an obtuse angle with the spine. This change in the position of the pelvis is the necessary result of the position in which the patient stands, and it sufficiently explains the apparent lengthening of the limb, which soon disappears on the patient being kept in the recumbent posture.

In the advanced stage of the disease the limb becomes not only apparently but really shortened; and this change may be produced in various ways.

1. The head of the femur and the bony margin of the acetabulum

may be in a great measure, or even in some instances wholly, destroyed by ulceration. Then there is nothing to prevent the action of the muscles from drawing the femur upwards, and the limb becomes shortened, as in a case of fracture of the neck of that bone.

2. In other cases, the cavity of the acetabulum having been gradually filled up by a deposit of lymph and pus, and the internal (or round) ligament having been destroyed by ulceration, the head of the femur is thrust outwards until it has passed beyond the projecting margin of the acetabulum, so that there is nothing to prevent the bone from being drawn upward by the action of the glutæi muscles. Thus the head of the femur is lodged on the dorsum of the ilium, with the usual symptoms of a dislocation of the hip upwards and outwards; the limb being shortened, the thigh bent forwards, and the toes directed inwards. In such cases the head of the femur never can be restored to its original situation; and in protracted cases, the patient being emaciated, and the muscles wasted from long disuse, it may be distinctly felt by the hand, as if it lay with little else over it than the common integuments.

3. In other but more rare cases the head of the femur is thrust out of the acetabulum, in the direction forward. It may then be felt in the groin, resting on the ramus of the pubes. The limb is shortened, but in a much less degree than where the dislocation has taken place upwards and outwards. The thigh remains nearly on a line with the trunk, and the toes are turned outwards. The difference in the result of these two kinds of dislocation, where the patient recovers, is very great. In the former case he is lame for life, can never bring his foot to the ground, and is doomed always either to walk with crutches, or to wear a machine to support the thigh, and fill up the interval between the foot and the ground. In the latter, the foot can be placed on the ground; and the patient can walk with perfect ease, although of course he limps, and is not fit for any very rapid kind of locomotion.

From whichever of the above-mentioned causes it may have taken place, the shortening of the limb is generally the forerunner of an abscess showing itself externally, and therefore it is always to be regarded as a very unfavourable symptom, not only in itself, but as indicative of other mischief. There are, however, some rare exceptions to this rule, and occasionally I have known the limb to be much shortened, and yet the patient to recover ultimately without the formation of abscess.

I believe that the history which I have just given will be found to represent with sufficient accuracy, the progress of this disease of the hip, such as it is in ordinary cases, and where it is not interfered with by successful surgical treatment. Anomalous symptoms may arise under the operation of circumstances peculiar to individual cases. I have known the whole of the affected limb to become œdematous and swollen to a great extent, apparently from obstruction to the circulation in the inguinal or external iliac veins, and yet the patient to recover. In the following case there were violent spasmodic actions of the muscles, quite different from those which produced the ordinary startings of the limb; and I am induced to place it on record, not only on account of its being remarkable in this respect, but also because it is very illustrative of nearly all the more important facts belonging to the pathology of this disease.

Case XXXI.

Captain D., in mounting his horse some time in the year 1820, experienced an acute pain in the right hip, which was not, however, of long duration. He afterwards felt occasionally similar sensations, which were generally induced by walking; but the pain was not severe, and therefore attracted very little of his attention.

In December 1822, he was attacked with pain in the same hip, which did not subside as formerly. It caused lameness, so that he could not proceed many yards without stopping to rest. This pain increased, and in February 1823, he suffered so much that he was wholly incapable of going from home except in a carriage.

He now consulted an eminent surgeon, who recommended the application of leeches, blisters, &c. One evening, after the application of leeches, he had a paroxysm of violent pain, attended with spasmodic action of the muscles of the thigh. The pain during this attack was so excruciating, that, to use his own expression, he wished for immediate death. He took not less than 150 drops of laudanum before he obtained relief. From this time, however, he was never wholly free from pain; and he was also liable to repeated attacks of more intense suffering, attended with violent spasms of the muscles of the thigh. The slightest motion of the limb induced one of these attacks of spasm, during which the thigh was jerked in a most remarkable manner for a period of some minutes. He was in this state when I was first consulted, in the summer of 1823. In September 1823, the spasmodic affection gradually subsided; and in the course of the October following, a tumour presented itself on the anterior part of the thigh, in the situation of the femoral blood-vessels. The tumour appeared to contain fluid, and in one part of it a pulsation was perceptible, which might have led a careless observer to mistake it for an aneurism. About the same time he became affected with a cough, lost his appetite, was languid, and exhausted by the slightest exertion. Soon afterwards he expectorated pus; and he died, with symptoms of *phthisis pulmonalis*, on the 11th of December.

On examining the body after death, the lungs were found extensively diseased, containing tubercles, many of which were in a state of suppuration. The cartilages of the right hip had been destroyed by ulceration, and the bones of the joint were in a state of caries. On making a section of the head of the femur, it was found to contain a less quantity of earthy matter than exists in a healthy bone, with a deposit of yellow substance in its cancellous structure. The synovial membrane and capsular ligament were considerably thickened, and a mass of coagulated lymph had been deposited round the neck of the femur. There was a collection of thin pus among the muscles on the internal part of the thigh

below the hip-joint, but communicating with it. The abscess formed a tumour of the size of a large orange, and, being situated under the femoral artery, the latter was thereby raised out of its natural situation. There were two enlarged lymphatic glands, each of the size of a walnut, immediately below the crural arch, on the fore-part of the joint, these being in contact with, and immediately behind, two branches of the lumbar nerves which lay over them, as the strings lie over the bridge of a violin.

No disease had been supposed to exist in the left hip previous to the patient's death, but on examining it afterwards, the head of the femur was found to be softer than natural, so that it could be divided with a scalpel. In some parts the vascularity of the bone was preternaturally increased; in other parts it was less than natural, and a yellow cheesy substance had been deposited in its cancelli. The synovial membrane and ligaments were in a natural state.

At the time when this case occurred, I was led to believe that the circumstance of the two branches of the lumbar nerves lying, as it were, stretched over the two enlarged lymphatic glands, afforded a reasonable explanation of the violent muscular spasms to which the patient had been liable. My later experience, however, has led me to doubt whether this be the correct explanation. It is to be observed that there was a deep-seated abscess situated among the muscles of the thigh below the hip-joint, beneath the femoral artery, and of course beneath the anterior crural, and close to the obturator nerve, and bound down by the femoral fascia; and that the subsiding of the spasms was immediately followed by the appearance of the abscess on the fore-part of the thigh. Precisely the same combination of circumstances existed in two other cases on which I was consulted; and from the state of these facts, it seems to me to be a just conclusion that the peculiar symptoms arose from the deep-seated abscess pent up among unyielding parts, and thus pressing on and irritating the anterior crural and obturator nerves, and that the abatement of them arose from the removal of the pressure on the nerves, by the abscess making

its way externally. It is worthy of notice that in a case of hernia of the *foramen ovale* of the pelvis, in which the intestine was strangulated in the opening through which the obturator nerve passes, the most distressing symptom under which the patient laboured was a painful spasmodic contraction of the muscles. This fact was reported to me by Mr. Weatherfield, of Covent Garden, by whom the patient was attended, and who gave me the opportunity of inspecting the parts after death.

The first indication of the disease, when it affects the knee, is generally an almost imperceptible limp in walking, occasioned by a slight degree of stiffness of the joint. This may exist for weeks, and even for some months, without attracting any serious attention. At last the patient begins to complain occasionally of pain; and now, on examining the joint, it is found to be slightly swollen, the enlargement appearing to arise altogether from a slight effusion of lymph into the cellular tissue external to the synovial membrane. The appearance of the joint is usually very characteristic. The leg is slightly bent on the thigh, and the condyles of the latter projecting anteriorly with the effusion of lymph which has been just mentioned, the knee presents a rounded appearance, which it is difficult to describe in words, but which the eye of an experienced surgeon will never fail to recognise. The leg admits neither of complete extension nor of complete flexion; but between these two points the mobility of the joint is but little impaired, and the movement of it gives no pain, if it be confined within the limits which have been just mentioned.

If the disease be still allowed to take its natural course, the joint becomes more and more enlarged, and the rigidity of it becomes more complete, until at last it admits of no motion whatever. The pain gradually increases, and by-and-by it becomes constant, there being at the same time a severe aggravation of it on even the slightest movement of the limb. The increase of pain here, as in cases of the corresponding affection of the thigh, indicates a more extensive destruction of the cartilages, and the commencement of suppuration within the joint. Ultimately

abscesses present themselves externally, and burst on the inside or outside of the joint, leaving sinuses which continue to discharge matter. These sinuses sometimes lead directly into the interior of the joint, so that a probe may be at once passed into it, and brought into contact with an exposed surface of bone. More frequently they take a circuitous course, winding under the fascia and among the tendons of the flexor muscles of the leg, so that their course cannot be traced by a probe.

Usually, when the knee is affected, the patient, if left to himself, keeps the leg in the half-bent state. The consequence is, that the flexor muscles acting feebly, but constantly, without any counteracting force, frequently draw the head of the tibia backwards towards the ham. In fact there is a complete dislocation backwards, the condyles of the femur making an unnatural projection anteriorly.

This disease is of not unfrequent occurrence in the joints of the tarsus. Here, also, it commonly for a considerable time attracts little or no attention. Ultimately pain is felt, there is an œdematous swelling of the tarsus, which ultimately includes the whole foot. In neglected or aggravated cases the swelling is sometimes enormous. Abscesses form, which are generally slow in coming forwards, and burst in various places. There is no form of the scrofulous disease of the joints worse in its symptoms or more difficult to relieve than this. It extends from one joint of the tarsus to another, and here, much more than in the less complicated joints, portions of bone are apt to lose their vitality, becoming afterwards detached, by ulceration, from the living bone, and forming exfoliations, which are so wedged in by the neighbouring structures that they can neither be brought to the surface by a natural process, nor safely removed by art. The progress of the disease in the joints of the *carpus* is very similar to that in the joints of the tarsus; but here, on the whole, it has a less formidable character. The difference is, I conclude, to be attributed to the tarsus having to support the weight of the body, and to its being at a greater distance from the vital organs.

It is unnecessary to enter into any specific history of the disease as it affects other joints, as, allowing for the difference in their situation and connections, the observations already made are applicable to them. It may be also needless to observe, that, whatever may be the joint affected, in the advanced stage of the disease the patient's general health suffers, as in cases of disease of the hip, though in a less degree when it has attacked the smaller joints than when it is seated in the larger.

Section III.

Treatment of Scrofulous Disease of the Joints.

Although the scrofulous disease of the joints presents itself under a great variety of aspects, and is always, even in the most favourable cases, tedious in its progress, and although there is no disease in which more depends on the surgical treatment employed than in this, still nothing can be more simple than the principles on which that treatment should be conducted. The observance of a few plain rules is all that is required in ordinary cases. At the same time, the surgeon whose notions have been formed by the study of the surgical literature of the last generation must endeavour to unlearn very much of what he has been taught. The disease is always indicative of defective bodily powers, and whatever tends to their further depression is injurious. The abstraction of blood, even by means of leeches, can be required only under some peculiar circumstances; and, even when it is thus required, the good which is done is not unmixed with evil. The repeated application of leeches may be regarded as never necessary, and as being invariably injurious. The same may be said of all kinds of what has been called counter-irritation, such as blisters, issues, setons, and the use of the tartarised antimonial ointment. There is one occasion on which some remedy of this kind may be employed for the relief of pain, as will be explained hereafter; but this is of rare occurrence, and otherwise

I am satisfied that all these painful remedies are not only not useful, but that they are actually mischievous. The maintenance of the general health is necessary to the patient's recovery, and as the long continuance of a purulent discharge cannot fail to be more or less injurious in that respect, it seems to be a very injudicious course to maintain such a discharge, for any long period, artificially. Children also suffer in another way. An open blister, or an issue, or seton, is a source of constant uneasiness, while the dressing which is required is a source of daily apprehension and anxiety. To those who know how necessary a hopeful and cheerful state of mind is to a vigorous and healthy state of body it would be a waste of time to point out the importance of this last observation.

The morbid condition of the bones, which precedes the ulceration of the cartilages and the formation of the abscess, is not to be relieved by local remedies. It depends altogether on the state of the system generally; and although, as I believe, some medicines may be prescribed with very great advantage, a still more important part of the treatment is, attention to the mode of life in other respects, persevered in during many successive years.

As a general rule, children who are thus afflicted will derive much benefit from passing the greater part of each year on the sea-coast. They may bathe in the open sea in the summer, and use the warm sea-bath during the winter. The air of the country is to be preferred to that of a crowded city, and in fine weather they should pass as much of their time as possible out of doors. They should live on a plain nutritious diet, avoiding many of those articles which are given to children, not because they are wholesome, but because they are agreeable to the palate. The bowels should be carefully regulated, without recourse being had to anything like drastic purgatives. Occasionally, a wrong state of the secretions furnished by the organs of digestion, may indicate the administration of some alterative doses of mercury, but mercury should never be used on any large scale, so as to place the system under its specific influence.

It is more difficult to determine the real value of remedies in a disease which is so completely chronic, than it is in acute diseases; but, from the long experience which I have now had, I am satisfied that, of what are called tonic medicines, none are so generally useful in these cases as preparations of iron. They must be given, however, not merely for a few weeks every now and then, but, with occasional intermissions, for a very long period of time. To children I generally give some simple preparation, such as the *vinum ferri* of the old pharmacopœia, or the syrup of the citrate, and sometimes of the iodide of iron, for three or four weeks. I then direct it to be omitted for a week or ten days, then to be given again; and so on, for two or three years, or even for a longer period. If the dose given in the first instance should prove to be too stimulating, it may be diminished. For those children with whom iron does not agree, other tonics, one at one period, another at another, may be substituted for it,—quinine, decoction of cinchona, sarsaparilla combined with the *liquor potassæ*, or infusion of gentian. The mineral acids, on the other hand, may be given when the appetite fails, or there is a disposition to night-sweats. I do not venture to say that the iodine of potassium, or other preparations of iodine, are never useful in these cases; but my own experience has led me to believe, that great as the beneficial influence of these remedies undoubtedly is in many other diseases, their usefulness in the various forms of scrofulous disease has been very much overrated. But there is another remedy, regarding which, although I have had much less experience of its effects than I have had of iodine, I cannot doubt that it may be often employed in these cases with the greatest benefit; I allude to the cod-liver oil. A child may take a teaspoonful three times daily, and an adult may take a proportionally larger quantity, for three or four months at a time. It is quite compatible with the exhibition of iron, which may be given in the intervals, or simultaneously with it.

With regard to local treatment, the question will here arise, if the surgeon is precluded from the use of leeches, blisters, and

issues, what is there left for him to do? The answer is, that in the early stage of the disease, the simple negative treatment, of keeping the diseased joint in a state of complete repose, is all that is required; and that this may, in the very great majority of instances, be best accomplished by the application of splints made of stiff leather, or gutta-percha, carefully moulded to the exact figure of the limb, and sustained by a suitable bandage. These splints may be lined with a soft leather, for which, however, in cases of abscess, and for the reasons formerly given, oiled silk may be substituted.

When an abscess is approaching the surface, and the skin is inflamed and tender, it will sometimes be necessary to remove the splints for a time, and have recourse to fomentations and poultices; but they should always be replaced very soon after the abscess has burst or has been opened.

It is not generally advisable to open an abscess while there is any considerable mass of substance between it and the skin, on account of the hæmorrhage, which, even when of trifling amount, may be productive of great mischief, in consequence of some of the blood finding its way into the cavity of the abscess, and mixing with the pus secreted into it. Such an admixture is liable to putrefaction; and, being in this state pent up within the cavity of the abscess, it produces all the symptoms of typhus fever, and may thus even lead to a fatal result.

As a general rule, I believe that it is advisable to open an abscess connected with a diseased joint, rather than to allow it to burst spontaneously; but the opening should be deferred until the skin is become thin over it, except in a few cases in which it is burrowing among the muscles of the limb under a thick fascia.

There are few questions in surgery of greater practical importance than that which relates to the management of an abscess connected with a diseased joint. The subject has been already briefly noticed in a former chapter; but it deserves further consideration. The observations which I am about to offer are applicable to all such abscesses, whether having their origin in the scrofulous

disease, or in any of the other diseases to which the joints are liable.

I have formerly made various experiments with a view to procure the absorption of these abscesses by artificial means; but as they were all alike unsuccessful, it is needless for me to explain them further than by stating the general result. Still I do not feel myself justified in asserting that there is no such thing as the spontaneous cure of an abscess by absorption. I have certainly seen several instances of tumours, having all the external characters of an abscess, which in the course of a few months, and sometimes in a much shorter space of time, have wholly disappeared. The question, however, will always remain, whether such a tumour was really an abscess, or simply a collection of serum. A young woman was admitted into St. George's Hospital, having a tumour containing fluid, tender to the touch, and with the skin over it inflamed, on the anterior part of the pectoral muscle, near the axilla. Not doubting that it was an abscess, I punctured it with a lancet, and a considerable quantity, not of pus, but of pure serum, escaped. Some time afterwards a similar tumour presented itself in the neighbourhood of the former one, which I did not puncture, and this disappeared spontaneously without discharging its contents. If I had not punctured the first tumour, I might probably have regarded each of them as affording an example of an abscess having been removed by absorption.

It is of great importance that tumours which are formed by a collection of serum should be distinguished from those which contain pus. However it may be as to the latter, there is no doubt that the contents of the former not only may be, but that they generally are, absorbed. At the same time a free opening of them is frequently productive of considerable inflammation followed by suppuration, and in many instances by great constitutional disturbance. Wherever there is any doubt on the subject, the tumour should first be punctured by a grooved needle, so as to ascertain the nature of its contents. If there be a serous fluid, no further opening should be made. If there be pus, a larger opening may be made afterwards.

I have not found that the method of treatment by evacuating the contents of the abscess and then healing the puncture, as recommended by the late Mr. Abernethy, is attended with any advantage where an abscess is connected with a carious joint. Indeed, this corresponds with what a little consideration might lead us to expect. If an abscess takes place as a primary affection, the disease being confined to the soft parts, there may be nothing to prevent the contraction of the cyst, and the gradual diminution of the quantity of pus evacuated at each puncture. But where an abscess occurs in consequence of an ulcerated state of the articular cartilages and bones, as the cause of the abscess exists equally after as before the puncture, the suppuration will necessarily be kept up, and the contraction of the cyst, and the obliteration of its cavity, will be prevented.

There are great objections to the opening the abscess by a small puncture. Even if the orifice should not (as frequently happens) become obstructed by portions of solid lymph impacted in it, neither at the time of its being made, nor afterwards, does such a puncture afford a free passage for its contents. A certain quantity of pus accumulates in the cavity of the abscess, the overplus escaping through the artificial orifice, as the overplus of water escapes through the waste-pipe of a cistern. Under these circumstances, the purulent discharge is invariably profuse; for a lodgement of pus operates like a pea in an issue, by stimulating the secreting surface and augmenting the secretion.

The practice which has appeared to me to be, on the whole, the best, is the following. An opening having been made with an abscess-lancet, the limb may be wrapped up in a flannel wrung out of hot water, and this may be continued until the first flow of matter has ceased, a poultice, or water-dressing, being applied afterwards. In some instances, after a short time the discharge ceases; the orifice heals, and the puncture may then be repeated some time afterwards. But when the puncture has not become closed, I have never found any ill consequences to arise from its remaining open. On the contrary, I have no doubt that it is desirable that

the wound should not be closed until the abscess has contracted, granulated, and healed from the bottom; and this is one reason for making, not a small puncture, but a free opening with an abscess-lancet. Another reason is, that the matter will escape readily without squeezing or pressure. *All rough manipulation is to be carefully avoided.* It produces hæmorrhage into the cavity of the abscess, the ill consequences of which I have already pointed out; and, independently of this, it may excite inflammation of the cyst, attended, where the surface is extensive, with so much constitutional disturbance as to endanger the life of the patient at the time, and materially lessen the chance of his recovery afterwards.

The treatment of the sinus which is left after the opening of an abscess may be comprised in a few words. If the orifice be disposed to heal prematurely, this may be prevented by the occasional application of the caustic potash, care being taken that the caustic does not enter the sinus itself; otherwise some simple ointment or a water-dressing is all that is required. The old practice of probing a sinus scarcely ever affords us any useful information; nor does it in ordinary cases answer any other good purpose. On the other hand, by irritating the sinus, or even the joint itself, it is often productive of serious mischief. The same observation is applicable, but with greater force, to the use of stimulating injections. I do not believe that they promote the healing of sinuses under any circumstances; but, with respect to those which are now under our consideration, there is no doubt that their operation is highly injurious. I saw a young man who nearly lost his life in consequence of a surgeon having ventured to inject port-wine into a sinus connected with some diseased or dead bone of the pelvis.

When this disease affects the hip the patient should be immediately confined to the recumbent posture on a bed or sofa; and this rule should be strictly observed, however little advanced the

disease may be. Long experience has satisfied me that it is impossible to arrest its progress, if the patient be allowed in the smallest degree to exercise the limb, or to allow it to support the weight of the body. In order that this part of the treatment may be fully carried out, it is desirable that the bedstead or sofa should be provided with the various conveniences belonging to that contrived by the late Mr. Henry Earle,* and that the patient's dress should be such as may be easily changed without his sitting up for that purpose.

It is very important that attention should be paid at an early period to the manner in which the patient lies. If left to himself we generally find him on one side, with the thigh bent at a right angle to the trunk, and the pelvis much twisted to one side. If he should recover with the limb ankylosed in this manner, the foot can never be brought nearer to the ground, and the limb is not only not useful, but actually an incumbrance to him. If the surgeon be not consulted until the disease is far advanced, it is not easy for him to rectify the mischief which has already taken place, but he can do much to prevent it if he be consulted in the beginning. The patient should be placed on his back, with the thigh, if not absolutely in a line with the trunk, bent only in a very small degree forwards. Not only will the limb be then a useful limb, even if the joint be ankylosed, but there will be a much less probability of the head of the femur escaping from the socket of the acetabulum, and being dislocated on the dorsum of the ilium. With a view to prevent the motion of the joint, and at the same time to maintain the limb in a proper position, a splint, such as I have already described, made of stiff and thick leather, or of gutta-percha, may be applied so as to embrace one side of the pelvis and two-thirds of the circumference of the thigh, and extending from the short ribs nearly as low as the knee. This, being fixed by a strap and a buckle to the pelvis, and in the same manner to the thigh, will be very convenient to

* Very useful bedsteads constructed on this principle, but with various improvements, are made by Chapman, in Soho Square.

the patient, and at the same time will well answer the intended purpose. Such a splint needs to be very rarely removed, except for the purpose of cleanliness when there are abscesses or sinuses discharging matter.

In some cases, where, the disease being in an advanced stage, there seemed reason to apprehend a displacement of the head of the femur with a retraction of the limb, I have endeavoured to prevent it by the application of a moderate but constant extending force. For this purpose a leather strap was applied above the condyles of the femur, having a string attached to it, passing over a pulley fixed, at a moderate height, to the lower end of the bedstead, and supporting a light weight; the pelvis being at the same time fixed by a strap to the middle or upper end of the bedstead. This in some instances seemed to relieve pain, and I am inclined to think that it was useful otherwise, by counteracting the muscles, which tended to draw the limb upwards. However, it almost always happened that something occurred to prevent the experiment being fully and fairly tried; and all that I can venture to say respecting it is, that it may be worth while in certain cases to give this mode of treatment a further trial.

Occasionally, when the disease in the hip has been productive of a more than usual amount of pain, I have known the patient to experience much relief from the application of several small blisters in succession, or from the insertion of a seton in the groin, immediately in front of the hip-joint. The large vessels and the nerve, which are here at so short a distance from the surface, seem to forbid the establishment of an issue by means of caustic in this situation. My conviction, as I have already stated, is that there is scarcely any other occasion on which it is proper to have recourse to any kind of counter-irritation in cases of this disease.

The length of time during which it is necessary that a patient labouring under the scrofulous disease of the hip should be confined to the recumbent posture must necessarily vary in different cases. Where the disease is in its advanced stage, with abscesses

already formed, no better cure can be expected than ankylosis, and for the completion of this process some years may be required. On the other hand, where suppuration is not yet established, a few months of strict confinement may be sufficient, all violent exertion being avoided afterwards. A girl sixteen years of age, who laboured at the same time under symptoms of caries of the spine and also of disease of the hip, died after having been under treatment for a few months. On examining the body it was found that there was extensive disease of the spine, with abscess. In the hip-joint there was no suppuration, the cartilage had disappeared from nearly one half of the surface of the acetabulum; but the ulcerated surface was completely cicatrised, the cartilage being replaced by a membranous substance which adhered closely to the bone, and completely covered what would have been otherwise a broad exposed surface.

In an old case of diseased hip-joint, the head of the femur may sometimes be felt lying on the dorsum of the ilium, and, in consequence of the general emaciation of the patient and the wasting of the muscles, with so little soft parts over it that it seems to be almost immediately beneath the common integuments. In such a case it has been proposed to make an incision on it and remove the head and neck of the femur by a saw. It would appear that this operation has been actually performed with some degree of advantage, and I do not doubt that circumstances may occur to make it worth while to have recourse to it. But it is to be observed, at the same time, that all that can be thus accomplished is the removal of one portion of the disease, and that it is the largest portion of it, in the bone of the pelvis, which is necessarily allowed to remain. The operation cannot be performed without a certain degree of local disturbance, and more or less of loss of blood; and, taking all those things into consideration, I conceive that we should not recommend it except where some very unequivocal advantage may be expected from it.

When the disease is seated in the knee, the joint is best supported by two lateral splints, broad enough to enclose two-thirds

(or more) of its circumference, and extending from the middle of the thigh to the middle of the leg. In cases of abscess the patient should be confined to a sofa or bed, until some very manifest improvement has taken place. Afterwards he may begin to walk with the aid of crutches, taking care that he never places his foot on the ground so as to throw on it the weight of the body. When there is no abscess he may use crutches from the beginning. If the leg be bent as the cure advances, the machine which I have already described, consisting of two splints (connected by a hinge) adapted to the posterior surface of the thigh and leg, and admitting of being approximated or separated by a screw, should be applied, so that the leg may be gradually brought into a more favourable position. This will promote the restoration of the mobility of the joint, if there be reason to believe that this object may be still attained; and if ankylosis be the result, it is important that it should take place under such circumstances that the patient may be able to use the limb in walking. The most convenient position for this purpose is that in which the leg is not quite extended, but very slightly bent on the thigh. It sometimes happens that the patella becomes ankylosed to the femur, while the tibia and femur are still movable on each other. This partial degree of mobility is not only no advantage, but it is a very serious disadvantage to the patient; and here the use of the splints should be persevered in until the femur is as firmly united to the tibia as it is to the patella.

When the disease affects the ankle, the joint may be supported by two lateral splints, including the lower part of the leg and the sole of the foot, and the patient may be allowed to walk, with the knee supported by a common wooden leg, such as is used when amputation has taken place below the knee.

Lateral splints may also be applied where the disease is in the joints of the tarsus. But where it has its seat in those of the metatarsus with the toes, or of the toes themselves, a leathern splint should be moulded to the entire sole, with its margins turned over the inside and outside of the foot. Over this a large

cloth boot, made to lace in front, may be worn, and the patient may then walk about as usual without any injury to the diseased joints.

The shoulder is not very commonly affected with the disease: when it is so the arm should be fixed to the side by a strap passing round the chest and fastened by a buckle, the forearm being supported by a light leathern boat suspended from the neck. In some cases also the shoulder may be protected by a leathern splint neatly moulded to its shape and fixed by a strap and buckle below the opposite axilla.

The diseased elbow is best supported by two lateral splints; as the wrist is by a splint adapted to its palmar surface, extending upwards to within a short distance of the elbow, and downwards to the tips of the fingers, and doubled at its margins over the sides of the hand and forearm. At first it is important that the motion, even of the fingers, should be prevented; but after some time a greater latitude may be allowed in this respect, and the splint may be shortened so as not to extend beyond the palm of the hand.

Splints are equally adapted to the smaller as they are to the larger articulations; and there is no part of the body in which the excellent effects of this simple mode of treatment are more manifest than in the thumb and fingers. Much, however, in these cases will depend on the mode in which the splint is applied. It is not sufficient, merely, that the splint should support the finger which is the actual seat of the disease, and in many instances it is advisable that it should be constructed so as to support the entire hand.

Among the labouring portion of the population, and in hospital-practice, the scrofulous disease of the joints always presents itself under unfavourable circumstances. The early symptoms by which it is indicated are almost invariably overlooked, and surgical advice is seldom obtained until the disease has made considerable progress. When, at last, the patient is admitted into an hospital, the affected joint is in such a state that some long period of time,

probably two or three years, may be required, even with the most careful management, for its cure. In the first instance, from the more complete repose and the better diet which the hospital affords, a manifest improvement takes place. But after the lapse of a few months the general health begins to suffer from the air of the hospital. The patient is then sent back to his own home, where he can neither have the proper attention nor partake of the generous diet which his case demands. The disease in consequence proceeds to its most advanced stage; and when for the second or, perhaps, for the third time he is admitted into the hospital, it probably is for no other purpose than that of having the limb removed by amputation.

Among the more affluent classes of society, and in private practice, the results are very different from those which have been just stated. Here it is the fault of the parents if the disease is not attended to in the first instance; and this being the case its progress may, by proper treatment, be almost always stopped, unless there is some more than usually unsound state of constitution. Even where there is extensive ulceration of the articular surfaces, and abscess communicating with the joint, in a patient under ten or twelve years of age, the limb may, in the great majority of instances, be ultimately preserved. The principal exceptions to this rule are those cases in which the disease has its seat in the tarsal joints. But for the attainment of a cure, in addition to skill and attention on the part of the surgeon, there is required a large stock of patience and self-discipline on that of the patient and his friends. It is no small proportion of those who are born to the enjoyment of ease and affluence who expect such an exemption from the evils of life as does not belong to human nature. Such persons, in cases of this as well as of most other chronic diseases, are too often not content to await the good which may gradually be obtained from a long perseverance in the use of some simple but efficient remedies. They pass from the hands of one empiric to those of another; listen to, and believe, any promises which are made to them; and at last, when it

is too late, discover that they have been in an error, and that, in their anxiety to obtain a speedy cure, they have lost the chance of that ultimate one which they might have obtained otherwise.

As the scrofulous condition of the bones is in these cases antecedent to the manifestation of the disease in the joint, so the apparent cure of the latter does not justify the conclusion that the bones themselves are restored to a healthy state; and for a long time afterwards it will be necessary that great attention should be paid to the patient's mode of life, and that he should persevere in the use of the remedies mentioned formerly, especially of preparations of iron. Without these precautions there is always a risk of the disease showing itself again, either in the joint originally affected, or in some other; and it may be observed that the same care which tends to preserve the joint may prevent the scrofulous disposition from manifesting itself in other and more important parts of the system.

It has been already stated that where the disease has not gone so far as to terminate in suppuration the patient may recover with an useful and movable joint, and that this may happen even when a considerable portion of the cartilage has disappeared; otherwise there is no recovery except with ankylosis. The ankylosis is at first only by soft substance—at last there is perfect bony union; so that when a section of the bone composing the joint is made, the cancellous structure of the one bone is plainly seen to be continuous with that of the other. But (in consequence, probably, of the peculiar state in which the bones are) there is reason to believe that a very long period of time usually elapses before this ultimate change is complete; and until it is so, all rough usage of the limb should be carefully avoided, and, in the lower limb especially, it will be prudent to keep the joint supported by something more than a common bandage.

It seems scarcely necessary, after the observations which have been already made incidentally, to add that where the organisation of the joint is completely destroyed, and the patient's general

health is failing, not from any concurrent disease of the vital organs, but from the disease in the joint itself, the only course to be pursued is the removal of the limb by amputation. But a question as to the expediency of an operation may arise under other circumstances. The patient has hitherto not suffered as to his general health, or has suffered only in a slight degree. The condition of the diseased joint is such that ultimate recovery is very doubtful, and it is certain that no better cure is to be expected than that by means of ankylosis, and even this cannot be looked for except after the lapse of a considerable time. Is the chance of the ultimate preservation of an imperfect limb sufficient to repay the patient for all the trouble and pain and anxiety which he must undergo in order that this object should be attained? Undoubtedly it is not, particularly with persons belonging to the lower classes of society, who have to support themselves by their bodily labour. There are, however, some other points to be taken into consideration, and altogether it is not so easy to determine respecting the propriety of an operation as on the first view of the subject it may appear to be.

A girl was admitted into St. George's Hospital, who laboured under this disease in the bones and joints of the tarsus. Her foot was amputated by Mr. Griffiths. In about three weeks the stump was perfectly healed; but now she was seized with symptoms which indicated an affection of the mesenteric glands, which had not shown itself previously, and she died. On dissection numerous glands of the mesentery were found enlarged, and containing a cheesy matter. Another girl, whose arm I amputated on account of a scrofulous disease of the elbow, became affected in the same manner immediately after the stump was healed. She also died, and similar appearances presented themselves on dissection. A man, whose leg was amputated on account of a scrofulous disease of the tarsus, in a short time after the operation began to experience symptoms which indicated the incipient state of pulmonary disease, and soon afterwards the other foot became affected in the same manner as the first. These are a few of many cases which

might be adduced, as leading to this conclusion—that the occurrence of this scrofulous disease, in a particular joint, may be the means of preventing the scrofulous disposition from showing itself in some other organ, and that if the affected joint be removed by an operation, there is more danger of disease breaking out elsewhere than there would have been if the operation had not been resorted to.

But we may refer to another order of facts as showing that there are occasions in which the amputation of a scrofulous joint, instead of rendering other organs more liable to the same disease, may actually produce the opposite effect of preserving them from it. It is to be observed that this disease of a joint is very rarely more than the remote cause of death, and that where the result is fatal, it almost invariably happens in the following manner. The patient is exhausted by hectic fever, and, in this state of debility, disease takes place in the mesentery or lungs, or not unfrequently in both these parts at the same time, and it is this visceral affection which immediately precedes dissolution. It is evident, then, that in many cases there is a period of time at which the amputation of the limb may be the means of preventing the establishment of a secondary disease. Nor is this all. Visceral disease, which was previously in a state of inactivity, may assume a new form, and begin to make a rapid progress, under the depressing influence of the disease of the joint; and amputation, under these circumstances, may be the means of preserving the patient, if not altogether, at least for a considerable time, perhaps for several years. A young woman was admitted into the hospital labouring under a scrofulous affection of the ankle. It was of long standing, and there were abscesses communicating with extensive surfaces of carious bone. It was evident that there was no chance of cure for the disease in the joint. Nevertheless I did not think it right to propose to the patient that she should submit to the loss of the limb, as she had a troublesome cough, with a purulent expectoration, and other marks of affection of the lungs. She, however, on account of the pain which she suffered, earnestly implored that

the ankle might be removed; and, not very willingly, I performed the operation. The stump healed readily. The pulmonary symptoms almost immediately subsided; and when I last heard of her, four or five years after the operation, she continued alive and well.*

It is evident, from these statements, that the question concerning amputation is, in many instances, one of a complicated nature, requiring the exercise of no small degree of judgment and discrimination on the part of the surgeon, and not to be determined, except after a minute investigation of the whole case, with respect to the disease in the joint itself, and also in whatever relates to the state of the general health at the time, and that of the constitution previously.

* In a former edition, I gave another account of the termination of this case which I have since found to be erroneous.

CHAPTER V.

ON ULCERATION OF THE ARTICULAR CARTILAGES.

SECTION I.

Pathological Observations.

IN the preceding chapters I have been content to assume it as a fact that the articular cartilages are liable to undergo changes corresponding to those which are the result of ulceration in other parts of the body, reserving the further consideration of this interesting subject for the present chapter, in which I propose to treat of ulceration of the cartilages occurring as a primary disease.

If a section be made of the articular cartilages in a growing child, canals or sinuses may be distinctly perceived in them containing red blood. These are not constructed with the distinct tunics of ordinary blood-vessels, nor is there any appearance of minute ramifications of vessels pervading the cartilage generally. Still it would be unreasonable to doubt that they are intended to convey blood into the structures for the purpose of nutrition and growth.

But after the period of growth is concluded, no blood-vessels can be detected in healthy cartilages even on microscopic examination; and as modern researches in anatomy have shown that not only nutrition, but absorption, and various changes of structure may take place in the living body, independently of any distinct vascular

apparatus, we are justified in the conclusion that, under the circumstances which have been just mentioned, no such apparatus exists.*

In cases of disease, however, I cannot doubt that I have myself seen blood-vessels extending from the surface of the bone into the substance of the adjoining cartilage. But examples of this are recorded in the preceding chapter. Mr. Mayo has described a similar appearance;† and the late Mr. Liston has published a drawing of such vessels, filled with injection, as they appeared in the field of the microscope.‡ The latter gentleman was kind enough to show me the preparation from which the drawing was taken, and it certainly seemed to me that there was no doubt that the parts were as they were represented by him to be. In saying this, however, I do not mean to affirm (nor did Mr. Liston, as I apprehend, mean to affirm), that blood-vessels extend into the articular cartilage of the adult when actually in a healthy state. It is, at all events, highly probable that some change in its molecular structure has always taken place before blood-vessels are generated in it; and in this there is nothing more remarkable than there is in the formation of vessels in extravasated lymph.

Interesting as these observations may be, as to the vascularity or non-vascularity of cartilages, and the mode in which the changes which they undergo in health and disease are produced, and important as the researches in minute anatomy conducted by means of the microscope may ultimately prove to be, it must be acknow-

* Mr. Toynbee was, I believe, the first to draw attention to the non-vascularity of cartilage, in a paper in the Philosophical Transactions for 1841, entitled, 'Researches tending to prove the Non-vascularity and the Peculiar Mode of Organisation and Nutrition of certain Animal Tissues.'—C. H.

† Medico-Chirurgical Transactions, vol. xix. p. 49. Mr. Liston, indeed, has stated that the preparations referred to by Mr. Mayo exhibit nothing satisfactory on the subject. But it is to be borne in mind that Mr. Mayo's observations were made on the recent subject, and that it is difficult to suppose so accurate an anatomist to have been deceived in so plain a matter; while it is highly probable that appearances which were quite distinct while the parts were in a recent state would be rendered obscure by long immersion in spirits.

‡ Medico-Chirurgical Transactions, vol. xxiii.

ledged that the time has not yet arrived at which the results can be applied, with much advantage to the advancement of practical surgery. In whatever way it may be accomplished, whether by the development and destruction of cells, or by means of capillary vessels, or partly by one and partly by the other, there is no doubt that cartilages are nourished and grow, and undergo changes of organisation, and that they are absorbed, and die, and exfoliate, very much in the same way as parts which are distinctly vascular. And, after all that can be said on the subject, the difference in these respects between cartilages and the other animal structures is probably more apparent than real. There can be no more doubt that the former derive new materials in some manner from the vessels of the bone to which they are attached, and that their old materials pass into the general circulation through the same channel, than that the fœtus somehow derives its nourishment from the maternal portion of the placenta. Nor should we lose sight of this consideration, that even in these organs which are endowed with the highest degree of vascularity, it cannot be supposed that every change which takes place is by the distinct agency of blood-vessels. The latter supply the new materials, but they cannot occupy every point of space; and there must be intervals between them in which it is probable that molecular changes are taking place, corresponding to those which occur in what are called extra-vascular organs.

In the museum of St. George's Hospital there is a preparation exhibiting the patella with its cartilage in a state of hypertrophy, that is considerably increased in thickness, though still retaining, apparently, its natural structure. Unfortunately, the particulars of the case are not recorded, further than that it was taken from a patient who had suffered from inflammation of the tibia.

The degeneration of the articular cartilages into a fibrous structure, the fibres being attached to the bone at one extremity, and projecting into the cavity of the joint at the other, is a

frequent occurrence, especially in advanced life. It often precedes other changes, as will be explained hereafter.

A wasting or total absorption of the articular cartilages may occur under a variety of circumstances. It may arise from mere want of use, under the influence of the same law as that to which we refer the wasting of a paralysed muscle. I was consulted respecting a young lady who had laboured under a caries of the dorsal vertebræ, with angular curvature of the spine. She seemed to have recovered of this complaint under the care of an eminent surgeon; but nevertheless she had (of her own accord and contrary to the wishes of her surgical attendant) remained in the recumbent posture for more than six years. I strongly advised her to begin to sit up, and then to stand and walk, and try to exercise her limbs. How it happened I know not, but she was taken into the country, and my advice was not followed. Some years afterwards I was again consulted, and now I found that there was not a single joint of the lower extremities which was not completely ankylosed. Every attempt to restore their mobility entirely failed, and it was impossible to doubt that the cartilages had entirely disappeared, and that the bones were connected by complete bony union. I conclude that, in such a case, the cartilages, in the first instance, became adherent, and then were gradually removed. In a case of ankylosis of the hip-joint which I had the opportunity of examining after death, but with the previous history of which I was unacquainted, this kind of ankylosis seemed to be in progress, there being a very thin layer of cartilage still perceptible, to which the surface of the acetabulum and that of the head of the femur were firmly united.

In a patient who died in St. George's Hospital, and in whom there had been a large abscess in the forearm, although that abscess had no communication with the wrist, I found a large portion of the cartilages of that joint to have become absorbed, the exposed surfaces of bone presenting very much the same appearance as if the cartilage had been removed by maceration. Two other cases similar to this have come under my observation,

there being in neither of them any sign of inflammation, nor of any other disease of the joint, with the exception of the absorption of the cartilage. I conclude that in such cases the wasting of the cartilage may be regarded as being simply the result of defective nutrition, which was itself to be attributed to the demand made on the circulation by the neighbouring abscess.

In like manner I have found, in experiments on animals, that the ligature of the femoral artery has retarded the union of a fracture of the tibia for several days, and that a large abscess accidentally formed among the muscles of the thigh prevented it altogether. I have in my possession a drawing of the astragalus of a patient who was under my care in St. George's Hospital, in which this wasting of the cartilage was seen in different stages of its progress. On one of the surfaces, although there is no part in which it has completely disappeared, the cartilage is everywhere so thin and transparent, that the colour of the bone may be seen distinctly through it.

In the case just mentioned, the original disease seemed to have been a chronic inflammation of one of the bones of the tarsus, not like that of scrofulous disease, but with a deposition of bony matter in the cancelli, causing their texture to be harder, and not softer than natural. In that disease of the joints, to which the name of rheumatic gout is commonly applied, a somewhat similar wasting of the cartilage occurs. I shall have occasion to refer to this subject again hereafter.

It is plain that the wasting of the cartilage which has just been described is a process different from that of ulceration. But I do not see what other name than that of ulceration can properly be given to the process by which the cartilage is absorbed under some other circumstances. We find it softened or otherwise altered in structure, occasionally with vessels carrying red blood ramifying in it, then gradually disappearing, often in such a manner as to present the appearance of distinct excavations in its substance; and these changes being preceded by, and attended with, distinct signs of inflammation, and immediately followed by ulceration, or caries

of the bone where the surface of it has become exposed, with suppuration, and abscess in the joint.*

Ulceration of the cartilage may begin on the surface by which the cartilage is in contact with the bone, or on the free surface towards the articular cavity; and examples of both these forms of the disease may be found among the dissections recorded in the preceding chapters. In the former case there is first an increased vascularity of the surface of the bone, with a less close adhesion of the cartilage to it; so that the two may easily be separated from each other. Then, in most instances, the cartilage is excavated in spots on the side towards the bone, the space thus excavated being occupied by a highly organised lymph. The ulceration, penetrating through the whole thickness of the cartilage, is at last seen on the inside of the joint as a very small opening, which gradually becomes wider. In other instances, instead of such partial excavations, the cartilage to a considerable extent becomes gradually thinner and thinner, until at last it lies like a mere membrane on the carious surface of the bone below, and then wholly disappears.

When the ulceration begins on the free surface of the cartilage, it sometimes is at its extreme border where the synovial membrane is reflected over it, or close to the attachment of the internal or round ligament in the hip, or of the crucial ligaments of the knee-joint. But the ordinary course of events seems to be the formation of shallow excavations, which afterwards assume the appearance of grooves at a greater or less distance from the margin, and

* On the subject of the molecular changes in the articular cartilages which occur in connection with disease, the reader may consult a memoir lately published by Dr. Redfern.

Mr. Birkett, in the Guy's Hospital Reports, observes, that 'it is now a well-established fact that there is no such morbid process as ulceration of cartilage. . . . . The destruction of this tissue depends on a loss of nutrition and disintegration, in which the development of fat plays an important part.' But it may be a question whether ulceration, in whatever part of the body it occurs, is not a process of disentegration, depending on a want of nutrition. Hence, as Hunter has observed, 'it becomes in many cases a substitute for mortification.'—Treatise on the Blood, &c., chap. vi.

frequently in the central parts of the cartilage, far removed from all the other textures of which the joint is composed. These grooves afterwards become wider and deeper, until the surface of the bone is exposed, which now becomes ulcerated or carious also.

The appearances which have just been described are sometimes met with in cases of inflamed synovial membrane having those processes or elongations extending into the cavity of the joints which have been formerly described. My friend the late Mr. Aston Key, in an interesting paper published in the 'Medico-Chirurgical Transactions,' has recorded the history of a case of this kind, in which the processes of the synovial membrane were seen lying in contact with the ulcerated surfaces: and from this and some other circumstances, he has been led to infer that this kind of absorption of the cartilage is to be attributed, not to any change originating in the cartilage itself, but to the action of the vessels of the synovial membrane; and, further, that when inflammation of the last-mentioned structure is followed by ulceration of the cartilage, the ulceration is always accomplished in the same manner; the vessels of the cartilage being, in fact, unequal to such a process of destruction.

If this opinion be correct, it establishes a new fact in pathology; as I am not aware that there is any instance in other parts of the body of the ulceration or absorption of one living texture being effected by the action of the vessels of another, there being no continuity of substance between them. I cannot, however, admit that the facts stated by Mr. Aston Key justify the conclusion at which he arrived. The fact is that the peculiar mode of absorption of the articular cartilages which is here referred to, is not at all confined to those cases in which inflammation of the synovial membrane has gone so far as to produce processes, or elongations of its substance, projecting into the articular cavity. It may be observed equally where no such degeneration of the synovial membrane has taken place, and even where the synovial membrane is not inflamed at all. Ample proofs of the correctness of this statement will be found among the dissections recorded in the

preceding chapters, and in those of which I shall give an account hereafter; and in adducing the following case, I am led to do so, not because such additional evidence is required, but because the evidence which it affords, is in itself sufficient, and that it may therefore prevent my having occasion to refer to the subject again hereafter.

Case XXXII.

A boy, 12 years of age, on the 28th of June 1809, fell from a height, and pitched on one of his knees. When he was brought to the hospital he was found to have a compound fracture of the femur. For some days he appeared to go on well; but afterwards an abscess formed in the thigh extending as high as the nates; and he sank and died on the 21st of July. On examining the knee-joint after death, the cartilage covering the condyles of the femur, and that covering the head of the tibia, were found, in some parts, entirely absorbed, so that the bone was exposed; while in other parts it was absorbed on the surface towards the cavity of the joint, the layer of it next to the bone retaining its natural adhesion, and apparently its natural structure. The cartilage, in these parts, was formed into grooves, having an appearance as if the greater portion of its substance had been removed with a chisel.

There was no purulent nor other effusion into the cavity of the joint; and in my written notes of the case, taken at the time, it is not mentioned that the synovial membrane was in any degree inflamed. The condyles of the femur belonging to this case are preserved in spirit in the museum of St. George's Hospital, and, on examining them, I find that throughout nearly the whole of its circumference, for the breadth of one-third of an inch, the cartilage remains of its natural thickness, and otherwise unaltered; while in the centre it has altogether disappeared, the grooved appearance being observable in the intermediate space.

I have already mentioned the occasional degeneration of some portion of the cartilages of a joint into a fibrous structure. Such

an alteration is not uncommon in advanced life; and it is met with occasionally in younger persons. It is one of the causes to which a crackling of the joints (of which I shall have to speak hereafter) is to be attributed. For the most part it leads to no further change; but in some instances it is the antecedent of ulceration, the cartilage being destroyed, to a greater or less extent, and the bone itself being rendered carious.

Case XXXIII.

In examining a body brought into the dissecting room in Windmill Street, I found the cartilage in a diseased state in the joints of both hips, of one of the knees, and of both elbows. In some spots the cartilages of these joints were altogether destroyed by ulceration, and carious surfaces of bone were exposed; in others the cartilage was not completely absorbed, but it had the appearance of fibres, which were connected at one extremity to the bone, while the other extremity was loose towards the cavity of the joint, and having no lateral connection with each other. The intervertebral cartilages connecting the bodies of some of the dorsal vertebræ were also in a diseased state. They retained the usual appearance of concentric layers towards the circumference; but in the centre, instead of the white semi-fluid substance which is met with under ordinary circumstances, they were found to be of a brown colour, of a solid and somewhat brittle texture, composed of several portions having a very slight adhesion to each other. The ligaments, the synovial membranes, and the bones were all in a natural state, except that the latter were in some instances carious, in consequence of the absorption of the cartilage, the caries being unattended by the formation of matter.

In several cases, of which an account will be given hereafter, a similar appearance of the articular cartilage was observed to exist, in connection with ulceration of the cartilage elsewhere, caries of the bone, and suppuration in the cavity of the joint.

In the preceding chapters I have given examples of ulceration of the articular cartilages occurring as the consequence of disease

of the synovial membrane, and also in connection with a peculiar morbid condition of the cancellous structure of the bone belonging to what is termed a scrofulous state of the general system. In either of these cases the primary disease may exist for a long time before the secondary disease is established. But there are other cases in which this order of things is reversed, in which the ulceration of the cartilage being the first change that can be detected, may be itself regarded as the primary disease.

This mode of expression is at any rate sufficiently accurate for all practical purposes, though it may not be always strictly and literally correct. Mr. Toynbee has shown that there is a peculiar structure of the plate of bone to which an articular cartilage is connected, by which the former is adapted to the support and nutrition of the latter, there being a relation between them corresponding to that which exists between the periosteum and the bone which it envelopes. As it may be a question whether the morbid action which produces a node of the periosteum begins in the bone, or in the periosteum itself; or whether it begins sometimes in the one, and sometimes in the other; so a similar question may arise as to the origin of ulceration, and indeed of the other diseases of the articular cartilages. These, and the plates of bone to which they are attached, may indeed be regarded as parts of the same system; and it is more than probable that no material change can take place in the one without the other being, in a greater or less degree, affected by it.

Having made this explanation, I proceed to give an account of some cases which are intended to illustrate the foregoing observations, and will, I apprehend, be found sufficiently to explain the progress of the disease as far as it can be ascertained by dissection. In this, as in other parts of this investigation, I have been at much pains to avail myself of the opportunities which accidentally occurred of examining the morbid appearances in the very commencement of the disease, being satisfied that it is only in this way that a just knowledge of this or of any other disease can be attained, and that pathological observations, if limited to those

cases in which disease has run its course, and all the textures of the affected organ are involved in one common destruction, are of comparatively little value.

Case XXXIV.

John Cutmark, 44 years of age, was admitted into St. George's Hospital, on the 29th of September 1813, with pains in the lower limb of the right side, extending from the hip to the knee, and resembling the pains of rheumatism. He attributed these symptoms to his having caught cold about a month before his admission. He laboured also under a complaint of his bowels, of which he died on the 4th of December. On dissection, no preternatural appearances were discovered except in the right hip. The capsular ligament and synovial membrane were in a natural state. The cartilage covering the head of the femur, and lining the acetabulum, had been destroyed by ulceration for about one half of their extent; and wherever the cartilage had been destroyed, an ulcerated surface of bone was exposed. The round ligament was readily torn, in consequence of ulceration having extended to it at the part where it was inserted into the acetabulum. The bones possessed their natural texture and hardness. There was no pus in the joint. It was observed that the ulcerated surface of the acetabulum corresponded to that of the femur, these surfaces having been exactly in contact in the position in which the patient had remained since his admission into the hospital.

Case XXXV.

Phœbe Harper, 24 years of age, was admitted into St. George's Hospital on the 29th of August 1825.

About two months previous to her admission, she had been seized, while employed in hay-making, with an excruciating pain in the lower limb of the left side. The pain subsided sufficiently to enable her to walk home; but on the following day it returned, and it was now referred principally to the groin. Leeches, blisters, and other remedies were employed, but the pain continued very severe.

At the time of her being admitted into the hospital, she was unable to move the limb; the foot was turned outwards, and every attempt to press the head of the femur against the surface of the acetabulum, as well as all pressure in the neighbourhood of the hip-joint, occasioned violent pain, so as to make her scream. The whole limb was of a higher temperature than natural, and the pulse beat between 90 and 100 times in a minute.

Altogether the disturbance of the constitution was greater than might have been expected from such a local complaint.

October 24th, the patient died.

On dissection it was found that no effusion either of serum, lymph, or pus had taken place into the cavity of the hip. The synovial membrane was somewhat more vascular than usual, but the increased vascularity seemed scarcely to amount to inflammation. The cartilage covering the head of the femur had been destroyed by ulceration for more than half its extent, the ulceration having proceeded so far as to expose the cancellous structure of the bone. The remaining portion of the cartilage covering the head of the femur was thinner than natural, but not uniformly so, the change being greater in some parts than in others. Everywhere the loss of substance was towards the cavity of the joint, the layer of it next the bone, where any cartilage remained, being unaltered.

The cartilage of the acetabulum was everywhere destroyed, and a carious surface of bone was exposed.

There were no remains of the round ligament.

The synovial membrane on one part of the neck of the femur was destroyed by ulceration, and here also a carious surface of bone was exposed.

The bones themselves had their natural texture and hardness, not differing from healthy bones except on the ulcerated surfaces.

Case XXXVI.

Ellen Davies, 18 years of age, was admitted into St. George's Hospital on the 2nd of September 1837.

She complained of great pain, referred to one hip-joint. The pain was aggravated by every attempt to walk, or bend the thigh on the pelvis, and when pressure was made on the joint. She was tormented by painful startings of the limb at night, and was pale and otherwise of a delicate appearance.

She said that she had first experienced pain in the hip about a year and a half ago; and from that time her sufferings had been gradually increasing. There was no perceptible swelling. An issue was made with caustic behind the great trochanter, and she was placed on an invalid bedstead.

She was otherwise in ill health, and died about a month after her admission into the hospital.

On dissection, the synovial membrane was found to be somewhat thickened, but it bore no marks of inflammation. Within the joint, globules of white lymph were found clustered in great numbers round the neck of the femur. There were no traces of the round ligament.

The cartilage belonging to the head of the femur had been destroyed by ulceration to a great extent, and that which remained had only a very slight adhesion to the bone.

The cartilage at the upper border of the acetabulum had been destroyed by ulceration also. At this part the head of the femur rested on the brim of the acetabulum, the projection of the latter being received into a groove of the other bone. The ulcerated surfaces of bone, where exposed by the destruction of the cartilages, were highly vascular.

I have placed the three foregoing cases first in order, as they exhibit the early changes which the disease produces with little or no complications. The three which immediately follow are of much interest, as they afford examples of the disease in its early and at the same time in its most advanced stage, in the same individual.

Case XXVII.

Thomas Herbert, 58 years of age, was admitted into St. George's Hospital on the 14th of September 1825.

He complained of pain and tenderness of the left knee. The leg was bent at a right angle with the thigh, and there was a severe aggravation of the pain on every attempt made to move it. There was a slight swelling of the joint, not arising from fluid in its cavity, but from an effusion into the cellular texture external to it.

The man was otherwise in ill health, and his memory was impaired, so that no history of the case could be procured.

Some time after his admission an abscess presented itself on the outside of the joint, and burst, discharging a large quantity of pus. It now became a question whether the limb should not be removed by amputation, but an attack of erysipelas prevented the operation. The patient gradually became more exhausted, and died in the beginning of December.

On dissection, the cartilage of the patella of the left knee was found in some parts destroyed, so as to expose the surface of the bone, while in other parts it had lost its natural structure, and was converted into a fibrous substance.

The cartilages of the head of the tibia and condyles of the femur were almost everywhere destroyed, so that extensive surfaces of carious bone were exposed.

The abscess did not communicate with the general cavity of the joint, but was limited to the portion of it formed by the external condyle of the femur and corresponding part of the tibia, and here the cancellous structure of the bones adjoining the ulcerated surfaces was of a dark colour. Everywhere else the bones belonging to the diseased joint retained their natural texture and hardness.

In the right knee, which had not been supposed to be diseased previously to the patient's death, the cartilage of the patella had in some parts entirely disappeared, so that the bone was exposed.

In other parts it had become converted into a fibrous substance, while elsewhere it retained its natural structure and appearance.

The cartilages of the tibia and femur of the right knee were somewhat thinner than natural, and of a yellowish white colour, but they were entire, except on the edge of one of the condyles of the femur, where the cartilage was in a state of incipient ulceration, the surface of the bone being exposed and of a red colour, in a spot about one-third of an inch in diameter.

Case XXXVIII.

David Martin, 26 years of age, was admitted into St. George's Hospital on the 25th of July, 1810, on account of a disease in his right knee. He attributed it to a blow which he had received some years previous; but he said that the symptoms had all been much aggravated within the last six months. At the time of his admission into the hospital, the knee had the appearance of being swollen; but, on examination, this was found to arise from the wasting of the muscles, rather than from actual enlargement. The leg was fixed, or nearly so, in the half-bent position. The condyles of the femur projected beyond the head of the tibia. He complained of pain, which was particularly severe at night. An issue was made with caustic on each side of the patella; but the symptoms were not relieved, and an abscess burst on the outside of the joint, discharging a large quantity of matter.

Soon after his admission, he experienced, for the first time, severe pain in the other knee; but this was unattended by swelling, or any alteration in the form of the joint, and the leg admitted of complete extension and flexion on the thigh. The pain continued, but no swelling ever took place.

In the beginning of September, he was seized with an accidental attack of erysipelas. Abscesses formed in different parts of the leg and thigh, and he gradually sank, and died on the 7th of November.

On inspecting the body the right leg was found bent so as to form a right angle with the thigh. The head of the tibia had

been drawn towards the ham by the action of the flexor muscles, so that the condyles of the femur were unusually protuberant. The lateral ligaments were in a natural state. There were no remains of the crucial ligaments, or semi-lunar cartilages. The cartilages of the tibia, femur, and patella had nearly disappeared. The bones were carious on their exposed surfaces, and dark-coloured, but not otherwise diseased. The synovial membrane was free from all morbid appearances, except at the points of its attachment to the bones, where, in a few places, coagulated lymph had been effused on its surface.

The left knee externally had its natural appearance, with respect both to form and size. The leg admitted of complete flexion and extension. On dissection, the ligaments and synovial membrane were found to be in a perfectly healthy state; but about one-third of the cartilaginous surface of the tibia and femur had been destroyed by ulceration,—having taken place principally, but not entirely, near the circumference. The cartilage of the patella and the semi-lunar cartilages were entire; but the latter in some parts were softer than natural. The bones were free from disease. There was no purulent nor other fluid in the joint.

Case XXXIX.

A girl, 7 years of age, was admitted into St. George's Hospital, in May 1809, on account of a complaint in the left hip. She had pain in the knee, the limb was shorter than natural, and the nates were wasted and flattened. An issue was made with caustic behind the great trochanter. Soon after her admission an abscess burst near the crista of the ilium. The disease in the hip appeared to be considerably relieved; but, on the 1st of August, she died of an accidental attack of erysipelas.

On inspecting the body, the glutæi muscles of the left side were found wasted, and of a dark colour. A sinus extended from the external orifice of the abscess through the soft parts, and communicated with the hip-joint, by an ulcerated opening in the margin of the acetabulum.

There were no remains of cartilage on the surface of the acetabulum, the exposed bone was in a carious state, and of a dark colour, and the cavity of the acetabulum was rendered deeper and wider than natural. The greater part of the cartilage was destroyed on the head of the femur, and the small portion of it which remained was readily separated from the bone; a circumstance which is often met with, where cartilage is undergoing the process of ulceration.

The capsular ligament was somewhat thicker than under natural circumstances, and more closely connected with the surrounding parts. There were no remains of the round ligament.

In the anterior part of the joint, a quantity of organised soft substance, resembling that of adhesions, was interposed between the head of the femur and the acetabulum, and behind this was a collection of dark-coloured pus. From these two causes the head of the femur had been protruded from its proper situation, being afterwards drawn upwards by the action of the muscles, so that it was lodged on the dorsum of the ilium above the bony margin of the acetabulum. The synovial membrane was of a dark colour, but not otherwise diseased.

On examining the hip of the opposite side, I found the soft parts external to it, the capsular ligament, synovial membrane, and fatty substance of the joint, having no appearance of disease. The cavity of the joint contained about a drachm of dark-coloured pus.

The cartilage was absorbed from about one-third of the surface of the acetabulum. The exposed bone in most parts presented an uniform compact surface, but in two places it was in a state of superficial caries. In some parts of the head of the femur, the cartilage had a fibrous appearance, similar to what has been already described; in other parts it was entirely absorbed, and a carious surface of bone was exposed, and elsewhere it was in a natural state. The round ligament was ruptured by a very slight degree of force, which seemed to arise from the cartilage having been destroyed near its insertion into the acetabulum.

The bones in the neighbourhood of the carious surfaces of the

left hip were of a darker colour than usual; but no such appearance was observed in the bones of the other hip, which were in all respects in a healthy state.

It would be impossible, merely from the appearance observed in a particular case, in which, either from neglect or from the insufficiency of the remedies employed, the disease had been allowed to proceed to its advanced stage, to presume what that disease has been in its origin, or what had been the tissue primarily affected. In cases such as those which I have just described, in which the opportunity of examining the morbid appearances occurred at an early period of the disease, no such difficulty exists; and with the knowledge which they afford, I do not hesitate to offer those which follow, as affording a further illustration of the destructive effects which the disease may ultimately produce in three of the principal articulations.

Case XL.

Jane Bannister, 40 years of age, was admitted into St. George's Hospital in September 1810, on account of a disease in the right foot. She gave the following account of her case:—

In the September of the preceding year she wrenched her instep, and soon afterwards experienced violent pain in the part, so that she was unable to stand on that foot, and her rest was much disturbed at night. The pain continued very severe, and, at the end of four months, she observed, for the first time, a slight swelling on the inside of the foot. This was occasioned by an abscess, which was opened by her medical attendant in the April following.

At the time of her admission into the hospital, the whole foot was swollen, and she complained of violent pain in it. The abscess continued open, discharging a small quantity of pus. On introducing a probe into the orifice, an exposed surface of bone was

felt. Several applications having been made without benefit, the leg was amputated on the 25th of February 1811.

On examining the amputated foot, the cartilage of the joint formed by the astragalus and os naviculare were found destroyed by ulceration, and a portion of the astragalus was dead, and undergoing the process of exfoliation. The cartilages of the joints formed by the cuneiform bones with each other, with the os naviculare, and with the metatarsal bones, were in like manner destroyed, and the exposed surfaces of bone were carious. The abscess communicated with the carious joints. The ligaments and synovial membrane were in a natural state, except in a few spots, where they had been destroyed by the abscess. The bones possessed their natural texture and hardness. The cellular membrane of the foot contained coagulated lymph and serum.

Case XLI.

William Bridges, 21 years of age, was admitted into St. George's Hospital on the 28th of November 1810. He gave the following account of his case:—

About the middle of the May preceding, he first experienced a pain in the right knee, which was aggravated by walking. At the end of a month, the pain became so severe, that he was under the necessity of being confined to his bed. He had slight pain in the hip; but that in the knee was intense, keeping him awake at night. An abscess formed, which, in the September following, burst on the inside of the thigh.

At the time of his admission, the nates were wasted and flattened, the limb on the affected side appeared to be an inch and a half longer than the other; there was a large abscess on the posterior part of the thigh. He was emaciated, and laboured under a hectic fever. An issue was made with caustic, behind the great trochanter of the femur, and afterwards a second issue was made in the same manner on the anterior edge of the *tensor vaginæ femoris* muscle. Under this treatment he experienced for a time great relief, notwithstanding that several abscesses formed and burst in different

parts of the thigh. He became free from pain, regained his flesh, the hectic fever abated, and the discharge from the abscesses was much lessened. The limb now appeared to be shorter than the other. He continued to mend till the middle of February 1811. At this period the unfavourable symptoms began to return. He was affected with a constant diarrhœa, and profuse perspirations, and he died on the 26th of March following.

On inspecting the body, the glutæi muscles were found wasted and shrunk, and in many parts their texture was destroyed by the abscesses, which communicated with the cavity of the joint by two ulcerated openings, one on the anterior, and the other on the posterior part. The abscesses formed several sinuses in the neighbourhood of the joint, and the capsular ligament was in consequence connected, and in some measure blended, with the other soft parts.

The joint contained purulent matter. The synovial membrane was darker than natural, but otherwise had the ordinary appearance. There were no remains of the round ligament. The cartilages were everywhere absorbed, and the exposed surfaces of bone were in a carious state.

The head of the femur was reduced to about two-thirds of its original size, and the acetabulum was rendered deeper and wider, nearly in the same proportion. At the bottom of the acetabulum there was an ulcerated opening just large enough to admit a common probe, communicating with an abscess within the pelvis. The carious surfaces of the bones had the same dark colour and fœtid smell as in other cases in which carious bones have been long bathed in pus, but otherwise they did not differ from healthy bones.

Case XLII.

Mary Anderson, 28 years of age, was admitted into St. George's Hospital on the 6th of April 1815.

At this time she complained of intense pain in the right knee, which was particularly severe at night, so as very much to inter-

rupt her rest. The pain was referred principally to the head of the tibia. There was a slight swelling of the joint, having the form of the articulating ends of the bones, and not giving to the hand the smallest sense of fluctuation. The leg admitted of being moved on the thigh, but all motion aggravated the pain.

No more particular account of the previous history of the case could be procured than the following;—that she had laboured under pains of the right knee for nearly six years, which had been occasionally relieved; and that, in the first instance, the pain had been unattended by swelling.

Immediately on her admission, an issue was made with caustic on each side of the patella. On the 9th of April the pain had very much abated. The issues were kept open by the occasional application of caustic, and the pains very soon left her, and the swelling diminished.

About the 8th of June she began to experience a return of the pains in the knee, and in the course of four or five days they were so severe as to keep her awake at night. There were convulsive startings of the limb, and the joint was swollen in a greater degree than formerly. The pains increased in violence, and her health began to suffer considerably. On the 3rd of July the limb was amputated.

On examining the knee, some lymph and serum were found effused into the cellular membrane external to it.

The cavity of the joint contained about half an ounce of thin purulent fluid. The cartilage covering the patella was in some parts in a natural state; in others it had the fibrous structure which I have described in a former part of this chapter; and in others it was completely destroyed by ulceration, so as to expose the surface of the bone. The cartilage covering the articulating extremity of the femur presented the same variety of appearances. On the inside there was a spot of some extent, which, instead of cartilage, was covered by a kind of membrane resembling the substance of adhesions, but somewhat more dense in its structure, as if the cartilage had been formerly destroyed at this part, and

coagulated lymph had been effused on the ulcerated surface of bone, and had afterwards become organised.

The cartilages of the tibia were ulcerated for a very small extent.

The synovial membrane in general was in a natural state. In some places it was slightly inflamed. On the outside of the joint it was inflamed in a greater degree than elsewhere, and thickened, and in a state of incipient ulceration in consequence of the abscess having begun to make its way towards the external surface.

The bones possessed their natural texture and hardness.

Sect. II.

Causes and Symptoms of this Disease.

There is this difference between the disease now under our consideration and that which formed the subject of our last chapter; the former belongs chiefly to the middle and subsequent periods of life, while the latter, in the very great majority of instances, occurs in children or in those who are little advanced beyond the age of puberty. This is a point of importance with reference to our diagnosis. Another circumstance not less important in this respect is, that the scrofulous affection of the joints generally is developed in those who are naturally of a weak habit of body, having what is called a scrofulous diathesis, or who are brought into that condition from insufficient nourishment, or under the influence of some depressing malady; whereas it is dyspeptic persons, of a sallow complexion, without any particular defect otherwise, who are more especially liable to the other disease. I have, however, observed that primary ulceration of the cartilages is often preceded by pains like those of rheumatism in other parts, and hence I have been led to conclude that it is, in many instances at least, the result of rheumatism affecting the harder textures. It will be seen hereafter, that the effect produced on it by certain remedies is favourable to this opinion as to its rheumatic origin;

and in further confirmation of it, I am led to give the particulars of the following case, which is interesting, not only because there is a distinct history of the local disease having been preceded by rheumatic pains elsewhere, but because the exact nature of the disease was ascertained by the dissection of the affected joint.

Case XLIII.

Sarah Holder, 22 years of age, was admitted into St. George's Hospital on the 26th of July 1827, with a diffused swelling extending from the upper part of the right thigh to the leg, a little below the knee. The swelling was most conspicuous in the immediate neighbourhood of the knee-joint, and from thence gradually became diminished, having no defined termination either above or below. It was somewhat elastic, the skin over it appearing glossy and tense, but not redder than natural. The patient complained of exquisite pain, especially on pressure. The pain was also aggravated by every motion of the knee; nevertheless it was principally referred, not to the joint itself, but to the thigh-bone immediately above it. In addition to these local symptoms, the pulse was frequent; the tongue furred and rather brown; the skin hot, and the countenance anxious and expressive of much suffering. The condition of the patient was altogether a good deal similar to that which might be produced by severe rheumatic inflammation of the bone and periosteum; and the history of the case seemed to justify the opinion that such was the nature of the disease, as the symptoms had begun without any precursory rigor on the day previous to her admission, and had been preceded, for an entire month, by what were regarded as rheumatic pains in the elbows and shoulders.

Saline and antimonial medicines were exhibited; leeches were freely applied to the limb, and on the 28th of July, a pill, containing two grains of calomel and half a grain of opium, was exhibited twice daily. Under this treatment, the gums became slightly affected, and the symptoms gradually abated. On the 3rd of August the mercurial pill was given only once daily, and

in the course of a few days more it was altogether discontinued, blisters being at the same time applied to the limb.

August 13. The swelling and pain had entirely left the upper part of the thigh; but there were still some remains of both in the immediate neighbourhood of the knee. Altogether she was in a much better state with respect to the local symptoms, and the general health was improving.

August 15. After an accidental exposure to cold, she had a rigor, followed by fever, and, at the same time, there was a recurrence of pain and swelling in the neighbourhood of the right knee, with some degree of pain and tenderness extending up the thigh, and down the leg. The swelling had the same character as formerly.

August 20. She continued in nearly the same state, with painful startings of the limb, and perspirations at night. The pulse was very frequent. She was directed to resume the use of the calomel and opium.

Sept. 2. There was no material improvement as to the local symptoms: a blister was applied to the knee.

She continued in nearly the same state, sometimes a little better, sometimes a little worse, with a very frequent pulse, and the general health, on the whole, declining, until the 7th of October, when an issue was made with caustic in the neighbourhood of the knee. The issue seemed to occasion some abatement of the local symptoms. Her bodily powers, however, continued to decline, and she became affected with an ulcer over the sacrum, the result of long-continued pressure.

Oct. 14. She complained of severe pain in the left shoulder.

Oct. 15. She was seized with a vomiting and purging, accompanied with pain and tenderness of the abdomen and cold extremities. Pulse 140. At midnight she had a severe rigor.

The vomiting and purging continued, in spite of the remedies which were employed. In the afternoon of October 16 she had another rigor, and in about two hours afterwards she expired.

On examining the body, the knee-joint was found to contain

neither pus nor synovia. The cartilage of all the bones which enter into the composition of the joint were ulcerated in several places, especially that of the inner condyle of the femur. A slight extravasation of blood had taken place into the cavity of the joint, apparently from the surfaces of the bone exposed in consequence of the ulceration of the cartilages. The periosteum could be easily peeled off the surface of the femur, and the bone underneath appeared to be more vascular than is natural. The stomach was distended with an acid fluid of a green colour, similar to what had been vomited on the day preceding death. The gall-bladder was full of a very pale yellow fluid. There were no other morbid appearances.

The left shoulder, to which pain had been referred for a short time previous to death, was carefully examined, but no disease was detected in it.

Mr. Mayo has published an account of some cases, in which ulceration of the articular cartilages had shown itself in the form of an acute disease, attended with urgent symptoms, and proceeding rapidly to its termination. Cases similar to those which he has described have fallen under my own observation; indeed that which has been just related (of Sarah Holder), may be considered as belonging to the class of acute rather than to that of chronic diseases. The following case is still more remarkable:—

Case XLIV.

A young married lady was seized with violent pain in one knee. There was no perceptible swelling of the joint, or, if there was any, it was not from fluid or lymph effused into its cavity, but from a very slight effusion of serum into the cellular membrane external to it. In the course of three or four days the pain became intense, and could be only partially relieved by very large doses of opium. Blood was taken from the knee by leeches and cupping, but this afforded very little relief. Mercury was administered internally,

and as soon as the patient was under the mercurial influence, the pain began to abate. In the course of a few days more it had entirely subsided. The patient was supposed to be well, but the bones were now firmly united with each other, so that the joint did not admit of the smallest motion. Various plans were tried with a view to restore its mobility, but to no purpose. The ankylosis was, and still is, complete; but as the leg is nearly in the straight position with regard to the thigh, it is productive of comparatively little inconvenience to the patient.

There is, however, no doubt that such cases are exceptions to the general rule, and that in the ordinary course of things ulceration of the articular cartilages, when it occurs as a primary affection, has the character of a chronic disease.

In many instances, the patient having previously complained of what he considered as rheumatic pains in his limbs and loins, finds these pains to become at last, as it were, concentrated in a particular joint. In others the disease is supposed to have followed some kind of mechanical injury. Statements to this effect, however, are not always to be received with implicit faith. There is a disposition in the human mind to trace whatever occurs to some known cause, and there are no occasions in which this disposition is more strongly manifest than in what relates to bodily ailments. I do not say that the disease now under consideration never arises from mechanical injury; but all my experience leads me to believe that the effect of such injury is much more frequently to cause the development or aggravation of a disease which had begun previously, than to bring a new disease into existence.

The pain in the joint in a short space of time becomes severe, so that even in what may be regarded as the earliest stage of the disease, it interferes with the patient's sleep at night. If proper treatment be not had recourse to, the pain continues to increase, is aggravated by any attempt to move the joint, and by the pressure of the articulating surfaces against each other, and at

last is attended with muscular spasms, causing involuntary startings of the limb, especially during the night.

The question here suggests itself, 'If the articular cartilages are not endowed with nerves, whence do such severe pains arise?' It may be answered, that we have no right to conclude, because no nervous fibres are detected in these structures, that therefore they are altogether without nervous matter, or placed beyond the sphere of the nervous influence. It may also be observed that there are other parts of the body which have been supposed to be possessed of great sensibility when in a state of inflammation, though under ordinary circumstances they have no sensibility whatever. Still I am myself more inclined to the opinion that the increased sensibility in these cases is in the bony plate beneath the cartilage rather than in the cartilage itself, and that the presence of severe pains, with involuntary startings of the limb, is always to be regarded as a sign of the bone partaking of the disease.

There is, in the first instance, no perceptible alteration in the appearance of the joint. After some time a slight degree of swelling shows itself, the consequence of a serous effusion into the cellular membrane external to it. It rarely happens that in the early stage of the disease there is any effusion into the articular cavity. I have, however, notes of a case in which this happened after well-marked symptoms of ulceration of the cartilages of the knee had existed, without swelling, for five months. The joint became suddenly and considerably swollen, the swelling subsiding afterwards under the application of blisters. I conclude that it arose from an attack of inflammation of the synovial membrane supervening on the original malady.

The cases already recorded show to what an extent ulceration of the articular cartilages may proceed without suppuration being established. This is a remarkable circumstance in the history of this disease, but not altogether peculiar to it. There is one kind of ulceration of the leg which I have occasionally met with in hospital practice, which affords an example of the same thing in

another order of textures. In the case here referred to, the patient complains of pain in one particular spot. Nothing is perceptible to the eye; but on placing the finger on it, the skin sinks into a pit, or depression, caused by the removal of the subjacent parts. By degrees the skin becomes thinner, and the depression more manifest. At last the skin is altogether destroyed by an ulcerative process extending from within outwards, and a painful irritable ulcer, now in a state of suppuration, is exposed.

In all cases, however, sooner or later, unless the ulceration of cartilages and bones be stopped by art, suppuration takes place, and abscess forms within the joint. It would appear that it is at this period that the greatest aggravation of the symptoms takes place; and now if the joint be not superficially situated, it becomes manifestly swollen from the purulent secretion collected in its cavity. If the joint be equally distended, it presents the same appearance as when it is swollen from an effusion of serum in consequence of inflammation of the synovial membrane. But in the majority of instances, the abscess being limited to one part of the joint, which is separated by adhesions from the rest, the swelling is of an irregular shape, prominent in one place, and scarcely perceptible in another. As the abscess increases in size, it gradually makes its way into the external parts, taking the course of an articular abscess arising under other circumstances.

Now this history is evidently very different from that of inflammation of the synovial membrane. The circumstance of the absence of swelling in the first instance in the one case, and the presence of it as almost the earliest symptom in the other, is alone sufficient to prevent an error in the diagnosis, when the surgeon is consulted before the disease is far advanced, or where an accurate statement of its progress can be procured. At a later period, indeed, when the whole joint has become disorganised, and the surrounding parts are penetrated by sinuses connected with it, it is always difficult, and in hospital practice often impossible, to arrive at an exact diagnosis. This, however, is of the less importance, as it would lead to no difference as to treatment, and as,

except in very young patients, any further attempt to preserve the limb, where there is nothing to prevent the removal of it by amputation, is for the most part unadvisable.

It is with the cases of scrofulous disease, having its origin in the cancellous structure of the bones, that those of primary ulceration of the cartilages are most liable to be confounded, as they resemble each other in the absence of all swelling of the joint in the first instance. But here also it is in the most advanced stage of the disease, when the joint is much disorganised, that there is the greatest difficulty in arriving at a correct diagnosis. At an earlier period the same difficulty does not exist. I have already adverted to the different periods of life at which these diseases respectively occur, and the different constitutions of those who are liable to suffer from them. The following are the principal points to be attended to besides. In the scrofulous disease it appears as if the sensibility of the bones was actually less than under ordinary circumstances, so that it may be going on insidiously for many months before it is productive of any serious inconvenience; and the pain which is at last experienced seems to arise rather from the joint being distended with matter, and from the abscess making its way into the surrounding textures, than from the actual ulceration of the cartilages and bones. But where the latter is the primary disease, the sensibility of the tissues seems to be morbidly increased. From the beginning there is pain on motion, and on pressing the articulating surfaces against each other; and, as has been already explained, only a short time elapses before the pain becomes severe and constant, causing great suffering, with involuntary startings of the limb; and this not only before there is any evidence of suppuration having taken place, but even in cases in which suppuration never takes place at all, so that a cure is effected without the formation of abscess. Indeed it is remarkable to what an extent this disease sometimes exists without abscess being the consequence of it, and this circumstance forms another important difference between these cases and those of scrofulous disease, in which it rarely happens that the

cartilage is destroyed, even to a very limited extent, without abscess showing itself afterwards.

After this general statement of the symptoms and progress of the disease, it will not be necessary to give any very extended history of it as it affects particular joints.

In this as in other cases, where the hip is affected, the pain is confined partly to the hip itself, but more especially to the knee. There is the same wasting of the muscles, producing a flattened appearance of the nates, the same apparent alteration in the length of the limb in the first instance, and the same real alteration afterwards, as in the cases of scrofulous disease. Here also there may be actual dislocation, the following example of which occurred under my observation, when I was yet a student at St. George's Hospital.

Case XLV.

—— Taylor, a middle-aged man, was admitted into St. George's Hospital, on account of a disease in his left hip. He laboured also under other complaints, of which he died a few months afterwards.

On inspecting the body, the soft parts in the neighbourhood of the joint were found slightly inflamed, and coagulated lymph had been effused into the cellular membrane round the capsular ligament. There were no remains of the round ligament. The cartilages had been destroyed by ulceration, except in a few spots.

The bones, on their exposed surfaces, were carious; but they retained their natural form and size. The acetabulum was almost completely filled with pus and coagulated lymph; the latter adhering to the carious bone, and having become highly vascular. The head of the femur was lodged on the dorsum of the ilium. The capsular ligament and synovial membrane were much dilated; and, at the superior part, their attachment to the bone was thrust

upwards; so that, although the head of the femur was no longer in the acetabulum, it was still within the cavity of the joint.

Allowing for the differences which have been already pointed out, the progress of the disease in the hip is very similar to that of the scrofulous disease of the same joint; so that much of what has been already observed respecting the latter, is applicable also to the former. The pain, severe as it may be before suppuration is established, is always aggravated afterwards, especially in those cases in which the abscess is confined to the deep-seated parts by the pressure of the *iliacus internus*, *psoas magnus*, and the *adductor* muscles of the thigh, and in which the sufferings of the patient are sometimes so intense as to be almost insupportable. The chance of ultimate recovery, where abscess connected with the hip is formed, under these circumstances is so small that the case may generally be considered as actually hopeless. Yet many recover, in whom the scrofulous disease of the hip has terminated in this manner. The difference is easily explained. The subjects of the last-mentioned disease are generally young children, and those of the former are generally adults.

The ulceration of the cartilage of the knee is indicated by pain in the joint, which at first is slight and only occasional, being completely relieved if the limb be kept in a state of perfect quiet for a few days; otherwise the pain becomes constant and severe, especially during the night, preventing sleep. The pain is referred principally to the head of the tibia, but sometimes a slight degree of pain with actual tenderness extends down the whole of the shin. It is aggravated by handling the joint, by pressure of the surfaces against each other, and by motion; so that the patient cannot bear to change his position, keeping the leg sometimes straight, but more frequently moderately bent.

A considerable time may elapse before there is any appearance of swelling, and when it does occur, it is no more than a slight enlargement of the joint, produced by an effusion of serum into

the surrounding cellular texture, quite different in its character from that which depends on the joint being distended with serum in a case of inflammation of the synovial membrane. Afterwards the existence of abscess is indicated by a great increase of size in some one part of the joint, there being perhaps comparatively little swelling elsewhere. There is now a further aggravation of the patient's sufferings. The abscess makes its way to the surface, sometimes in one direction, sometimes in another; and ultimately there may be two or three or more sinuses leading to the interior of the joint.

In these cases also there may be a dislocation of the joint, produced by the action of the flexor muscles, where the leg has been kept in a half-bent state, drawing the head of the tibia into the popliteal space. I have known this to happen even when the disease has not gone so far as to occasion abscess. In the instance to which I allude, the patient recovered with the leg fixed in this unnatural position.

The history of this disease, as it affects the knee, is applicable with some slight and obvious modifications to the other joints which are superficially situated. The first symptom is pain unattended by swelling, and increased by the forcible pressure of the articulating surfaces against each other. The pain is always referred to the part which is the actual seat of the disease; when the elbow is affected, the more severe pain in that joint is accompanied by a slighter degree of pain in the lower part of the forearm and wrist. It cannot be said that any joint in the body is altogether exempt from the disease; but the liability to it is much greater in some joints than it is in others. It is very rarely met with in the joints of the lower jaw; and it is for this reason that I think it worth while to record the following case, it being the only one of the kind which has fallen under my observation.

Case XLVI.

A lady, 33 years of age, in November 1816 first experienced a pain in the articulation of the lower jaw, on the left side; and this was attended with a sense of stiffness, and a difficulty of taking and masticating food. Some liniments were used, which seemed rather to aggravate the complaint, and were therefore left off. From this time the symptoms gradually and slowly increased; and in May 1818, when I was consulted, they were as follows:—There was severe pain in every motion of the lower jaw, especially in masticating the food and yawning. The pain was induced whenever pressure was made in the situation of the articulation of the lower jaw of the left side; but there was no tenderness on pressure being made elsewhere. From this part, however, as from a centre, the pain extended in various directions; to the temple, to the back of the head towards the lambdoidal suture, to the lower part of the orbit of the left eye, and even down the left arm. She said that it was impossible to describe the character of the pain, as she had experienced nothing like it before. When the fingers were applied to the joint, and the lower jaw was at the same time opened and closed, a grating sensation was communicated to them, as if the articulating surfaces had been deprived of their cartilages. There was no evident tumefaction. The patient did not complain of her sleep being much disturbed, nor did her general health appear to be considerably affected, though her pulse was as frequent as 96 in a minute.

The caustic potash was applied so as to make a slough of the skin below the ear, opposite the condyle of the lower jaw, on the anterior edge of the *sterno-cleido-mastoideus* muscle. She now returned into the country, where she was under the care of Mr. Pitman of Andover, who removed the slough made by the caustic, and kept open the issue in the usual manner.

After the issue had been established for five or six months, and not before, there was considerable relief from pain. On the 21st of August 1822, Mr. Wm. Pitman wrote me the following account

of our patient:—'At this time she has the perfect motion of the jaw; but there is still the same grating sensation when it is moved as there was formerly, though in a less degree. She has the power of masticating almost all articles of food which are not very hard. The condyle does not seem to be much reduced in size: when, however, the mouth is opened, as in yawning, our patient generally places her hand to support the jaw, as if fearful that it might slip out of its place. With all this amendment, however, there is pain occasionally; and as there has never been an absolute cessation of pain for more than three or four weeks at a time, the issue is still kept open.'

Although from the time when I began the practice of my profession my attention has been directed to the pathology of the joints, and my opportunities of studying the subject have been very extensive, I am quite aware that the results of my observations cannot be offered to the profession as approaching to anything like a perfect system; and that even if it were in my power to pursue my inquiries for many years to come, there would still be much left to reward the labours of those who may be disposed to engage in similar researches.

These and all other diseases which, either in the beginning or ultimately, cause an alteration in the structure of the diseased organ, may be considered under two points of view. They may be regarded merely as an assemblage of symptoms, running a certain course; and as such they are quite proper objects of study. They may thus be recognised in the living person, and distinguished from each other; and without any further knowledge respecting them, we may be enabled to discover efficient modes of treatment leading to their cure. But they may be regarded also with a reference to their more intimate nature, and the changes which are actually going on in the living body; and here a kind of knowledge is required, which cannot be obtained without dissection and anatomical inspection of the diseased parts. The

importance of morbid anatomy, in enabling us to obtain a greater insight into disease, cannot be too highly estimated. But it has not the same value under all circumstances. The dissection of a joint, or of any other organ, in the advanced stage of a disease, when all its component parts are involved in one mass of destruction, can give us little real and useful information as to what was the original nature of the disease, or as to the particular texture in which it began; nor can it afford us the smallest hope in solving the most important problem of all, namely, the means of cure. It is only from the examination of the changes produced by disease in its very commencement, or before it has made any considerable progress, that we can arrive at any satisfactory conclusion on these points. With the preliminary knowledge thus obtained, the dissections made at a later period become intelligible and useful, and without them they are of little or no value. But the joints are not vital organs; and the diseases to which they are liable being, with few exceptions, of a chronic character, the opportunities of examining the morbid appearance at an early period are of rare occurrence, and can be only accidentally obtained. I have made these remarks in order that my object may not be misunderstood in introducing in this place the following account of a somewhat peculiar affection of the shoulder. I cannot so well explain the circumstances belonging to it, as by supposing that the original disease is ulceration of the articular cartilages; but I have not had the opportunity of satisfying myself on this point by dissection; and it is therefore not impossible that in some future edition I may have to transfer the history to another part of the volume.

The cases here referred to occur more frequently in private than in hospital practice: and (whether it be accidentally or not I do not know) it certainly has happened that I have met with it more frequently in the female than in the male sex. The patient complains of pain, which however is referred not so much to the joint itself as to the arm a little below it, near the insertion of the deltoid muscle. At first the pain is trifling, but it soon becomes severe and constant. The patient describes it as a *wearing* pain,

of which she is constantly reminded. It is aggravated by every motion of the limb, and by pressing the articulating surfaces against each other. Not only is there no perceptible enlargement of the shoulder, but after some time, in consequence of the want of use and wasting of the deltoid muscle, it seems to be actually reduced in size. It is not long before the mobility of the joint is impaired, becoming gradually more and more limited. When the patient attempts to raise the elbow from her side, it is observed that the scapula is elevated at the same time with the humerus. She is unable to raise her hand to her face, nor can she rotate the limb so as to place it behind her. When the progress of the disease is stopped at an early period, the mobility of the joint may be restored; but otherwise, although the pain and all other symptoms of the disease have subsided, the joint remains stiff, and to all appearance completely ankylosed. Whatever motion the arm is capable of, under these circumstances, depends not on the humerus but on the scapula; and it is remarkable to what an extent the scapula, or rather the muscles belonging to it, will accommodate themselves to this new state of things, so as to make up for the deficient motion of the shoulder.

It certainly is seldom that this disease terminates in abscess of the joint when proper attention has been paid to the treatment of it, nor has this happened in any case in which I have had the opportunity of closely observing its progress. I have, however, seen cases of abscess with ulceration of the cartilages, and complete destruction of the shoulder-joint, in which I conclude that, if I had been consulted at an early period, I should have found the symptoms to correspond with those which I have just described.

Whether it be from this, or from any other disease, that the joint of the shoulder is brought to such an extreme state of disorganisation, one result is, that it is liable to dislocation, or, more properly, to sub-luxation in the direction forwards. In one case in which I had the opportunity of examining the parts after death, I found the anterior margin of the glenoid cavity of the scapula destroyed by ulceration, the head of the humerus permanently

resting on the ulcerated surface. In another case, in the living person, I found the dislocation to be only occasional, the head of the bone slipping forward so as to make a visible projection in certain motions of the arm, and in certain other motions returning to its natural situation.

I may take this opportunity of noticing another circumstance which, though not of much interest in pathology, is of some importance in practice. An abscess originating in the shoulder-joint sometimes presents a peculiar appearance, when it is making its way to the surface. A dissection, which I once had the opportunity of making will explain at once the nature and the cause of this peculiarity. The abscess, taking the course of the tendon of the long head of the *biceps flexor cubiti* muscle, had suddenly emerged from the joint at the lower end of the bicipital groove of the humerus; then, having taken a direction forward, on the anterior edge of the deltoid muscle, had presented itself under the integuments, having a spherical form, so that it might have been mistaken for an encysted tumour. I met with one case in which this mistake respecting an abscess of this kind was actually made by a surgeon of considerable experience, who proposed the removal of the tumour by the knife.

Sect. III.

Treatment of this Disease.

In these as in most other cases of disease of the joints, the first question that will arise in the mind of an experienced surgeon is, whether suppuration has or has not already taken place in the articular cavity? If he be compelled to answer this question in the affirmative, there is no chance of the limb being preserved even in the child, except after a long and tedious process of treatment, nor without complete ankylosis of the affected joint; and in the adult the probability of obtaining even this imperfect cure is so

small that no one can be justified in offering any but the most unfavourable prognosis. And be it observed, that the question is not merely as to the actual existence of any considerable purulent deposit; but that a single drop of matter is always to be regarded as the nucleus of a large abscess, which will sooner or later present itself externally, in defiance of all the means that can be had recourse to to prevent it. If, on the other hand, circumstances justify the opinion that suppuration is not yet established, and a proper mode of treatment be at once begun and strictly carried out, it will be found that there are few diseases more under the control of the surgeon than this, or in which art can be employed with more decided benefit to the patient.

The observations which I formerly made as to the necessity of preserving the joint in a state of absolute and complete repose, and of attending to the position of the limb, are equally applicable to the cases whch are now under our consideration, as to those which formed the subject of the preceding chapters. It cannot be necessary for me to repeat the rules which have been already laid down for the better accomplishment of this important object. I need only observe that, unless these rules be strictly observed, there is not the smallest prospect of advantage from any other treatment.

In the early part of my practice I was accustomed to regard the ulceration of the articular cartilages as a disease which was to be relieved almost exclusively by local remedies, and that the only thing to be observed besides was, that ordinary attention should be paid to the maintenance of the patient's general health. Experience, however, has long since led me to a very different conclusion, and has satisfied me that there are remedies which, acting through the medium of the constitution, exercise a most beneficial influence over the local malady, and by the judicious application of which many cases may be brought to a favourable termination, in which this could not have been accomplished otherwise. The remarks which follow are applicable not only to cases of ulceration of the cartilage, where it occurs as a primary disease, but also to

those described in the first chapter, in which the cartilages are ulcerated as a consequence of inflammation of the synovial membrane.

In the acute form of the disease mercury may be administered with the greatest advantage; and usually it will be found, as soon as the system is thoroughly under its influence, that the pain and startings of the limb are diminished, and, if the treatment be continued, in the course of ten days or a fortnight, that they are relieved altogether. The mercury should be exhibited freely, as in a case of iritis, and so as to produce a moderate degree of soreness of the gums. Thus two or three grains of calomel, combined with sufficient opium to prevent it from acting on the bowels, may be given three or four times daily in the first instance, the dose being reduced according to circumstances afterwards; or, if mercury taken internally should disagree with the patient, mercurial inunction may be had recourse to instead, the ointment being rubbed in, not on the limb which is the seat of the disease, but on some other part of the body. As soon as the symptoms are completely relieved, the mercurial treatment has done its duty and may be discontinued. A short time will show whether the disease has been stopped at a sufficiently early period for the patient to regain the use of the joint, or whether the disease must terminate in ankylosis. The latter is, if I am not mistaken, in these cases, the most frequent result.*

In those cases, in which the disease assumes a more chronic form, mercury is also a most efficient remedy. It may, however, be administered in smaller doses, so as to bring the system more gradually under its influence. Calomel may be given combined

* Although on a reference to the two last editions of this work (see the cases of Sarah Holder and Sarah Hansell), it will be seen that I had long since occasionally had recourse to the mercurial treatment in cases of ulceration of the articular cartilages; still I must acknowledge that I had not been in the habit of using it generally until I had read the statement published by Dr. O'Beirne, in the Dublin Medical Journal for May 1834; and I gladly avail myself of this opportunity of expressing my obligations to that gentleman for having brought the subject more distinctly under the notice of the profession.

with opium or with henbane; or the common mercurial (or blue) pill, or the bichloride.* The latter my be given in combination with sarsaparilla; or a mercurial pill may be given at night with two or three grains of iodide of potassium in solution twice daily at the same time. Sarsaparilla may also be administered alone with the greatest benefit, where for any reasons it is desirable that the use of mercury should be avoided, care being taken on this, as on other occasions, that it is of the best quality, and taken in sufficient quantity.

The influence of this class of remedies in cases of ulceration of the cartilage, is favourable to the opinion which has been already expressed, that this disease is, in some instances at least, of a rheumatic character. It may be observed that I have not recommended the exhibition of mercury, where the cartilages are affected as the consequence of scrofulous disease of the cancellous structure of the bones. I have no experience which could lead me to believe that it can be given with advantage in the last-mentioned cases; and there can be no doubt that the influence of it on the constitution, as a depressing agent, must in them be injurious. Practically there is little difficulty in distinguishing when mercury may or may not be properly had recourse to. If, in the early stage of the disease, that is previously to suppuration having taken place, there be severe pain, with involuntary startings of the limb, and especially if these symptoms have been preceded by rheumatic pains elsewhere, the mercurial treatment will generally be productive of the greatest benefit. If abscess be already formed it is certainly useless, and may probably be injurious.

* The bichloride is best administered in the form of a pill, for which I generally use the following formula, which was given to me by the late Mr. Pearson:—

℞ Hydrargyri bichloridi, gr. j.
Ammoniæ muriatis, gr. iii.
Aquæ destillatæ.
Medullæ panis āā quantum sufficit.
Misce ut fiat massa, in pilulas dividenda.

From one sixteenth to one eighth of a grain may be thus administered two or three times daily; or half a grain may be given during a meal, so as to be mixed with the food.

As a general rule, the abstraction of blood from the neighbourhood of the affected joint is not to be recommended. There is no more reason to believe that blood-letting would stop the progress of ulceration in cartilage or bone, than that it would stop that of ulceration of the skin of the leg. But, as in the latter case, if the patient, by too freely using the limb has brought on inflammation of the surrounding parts, such inflammation may be relieved by the application of leeches; so may the abstraction of blood by leeches or cupping be useful where inflammation has supervened in a case of ulcerated joint as the result of incautious movements. It is, however, only in a few instances that this is required at all; and it need scarcely ever be repeated.

I have formerly expressed my opinions as to the inefficiency of setons, issues, and other (so-called) counter-irritants in cases of scrofulous diseases of the joints. I do not hold the same opinion respecting them in cases of ulceration of the cartilage from other causes. I have indeed no doubt that in such cases they are often useful in affording more complete relief from pain than could have been obtained otherwise, as well as in preventing suppuration. In some instances, a blister of a moderate size, and kept open by means of the savine cerate for a limited period of time, will answer the intended purpose. Where a more permanent influence of this kind is required, an issue made with caustic is to be preferred. The caustic potash may be rubbed on the surface of the skin, or the Vienna paste may be applied, so as to produce an eschar extending to the subcutaneous texture; and when the eschar has separated, the sore may be kept open as an issue, either by dressing it with peas, in the usual way, or by rubbing the granulations once or twice in a week with the caustic potash, some lint spread with the savine cerate being applied in the intervals. The issue should be in some convenient situation in the immediate vicinity of the diseased joint. If the hip be the part affected, it may be behind the great trochanter; if it be the shoulder, it may be on the fore part below the situation of the coracoid process; and if it be the knee, two issues of a moderate size may be made, one on

each side of the patella. When the seat of the disease is in the elbow, wrist, or ankle, an issue is generally productive of much inconvenience; so that I am unwilling to recommend it, except as a matter of necessity. When there is disease in the hip, with a more than usual amount of pain, much relief is sometimes afforded by the insertion of a seton in the groin. On this point I may refer to the observations which I made when treating of the scrofulous disease of the same joint.

The actual cautery, or the moxa, may be used for the purpose of making an issue, instead of the caustic potash; but I am not aware that they possess any advantage over it, and they have the disadvantage of being more alarming to the patient.

Before I dismiss this part of our inquiry, I must, however, confess that even in cases of primary ulceration of the cartilages I am less disposed to the employment of issues and other remedies of the same class, than I was formerly. Where abscess has already formed, they certainly are a mere useless addition to the patient's sufferings, and even when there is reason to believe that the disease has not yet advanced to suppuration, with my present experience, I seldom recommend them unless I find that the symptoms do not readily yield to other treatment, or that they are unusually severe.

The treatment of abscess in these cases does not differ from that which is required in other cases of diseased joint; and it is sufficient for me to refer to what I have said on that subject in the preceding chapters. Neither need I repeat what I have already stated as to the small chance which there is of recovery, at least in the adult, in this last stage of the disease. Certainly we are never justified in proposing the amputation of the limb, or the excision of the joint where there is no adequate reason for believing that suppuration has taken place. Where abscess already exists, if the patient's general health be not materially affected, we may endeavour, by the application of splints, or by taking care that the contents of the abscess are enabled freely to escape, to obtain ankylosis; but the experiment should not be

obstinately continued where there is not a good prospect of its success; it being better that the patient should lose the limb than incur the risk of losing his life while we are endeavouring to preserve it.

Even where suppuration of the joint has not taken place, if the cartilages are extensively destroyed, it is not to be expected that there will be any other recovery than that by ankylosis; but where there has been only a partial destruction of the cartilage, the joint may retain its natural degree of mobility. And here the question will arise, what is the state of the articulating surfaces under these circumstances after the cure has taken place?

Cases will be found recorded in other parts of this volume, in which the bony surfaces of a joint were covered by a dense membrane, formed to supply the place of the cartilage which had been destroyed; and I cannot assert that this membrane is never ultimately converted into the true cartilaginous structure. In other instances a compact layer of bone is generated on the carious surface, nearly similar to what is seen in the healthy bone after the cartilage has been destroyed by maceration. I have occasionally, in dissection, observed a portion of the cartilage of a joint wanting, and in its place a thin layer of hard, semi-transparent substance, of a grey colour, and presenting an irregular granulated surface. It is probable that in these cases also the original disease had been ulceration of the cartilages. The following case affords an example of another change which is sometimes met with where the cartilages have disappeared.

Case XLVII.

A woman, 36 years of age, was admitted into St. George's Hospital, with pain in the hip and knee on one side. The nates were wasted and flattened, and a large abscess had burst, leaving a sinus communicating with the hip-joint. She was affected with hectic fever, and gradually sank and died.

On inspecting the body, various sinuses were found in the neighbourhood of the hip, and communicating with it.

The synovial membrane and capsular ligament had undergone no alteration in their appearance beyond that which evidently depended on the abscess. The cartilage had been everywhere absorbed from the articulating surfaces, and in its place there was a thin crust of bony matter of a compact texture, of a white colour, not very unlike polished marble in appearance.

CHAPTER VI.

NECROSIS OF JOINTS.

Case XLVIII.

John Curtis, 15 years of age, was admitted into St. George's Hospital on the 11th of October 1837. He complained of pain in the right knee, in which, however, there were no other signs of disease. He also complained of pain in the right hip, which was increased when the articulating surfaces were pressed against each other. When the thigh was raised, it was observed that the pelvis moved with it. He was apparently of a delicate constitution, with light blue eyes and light hair.

He was directed to remain in bed, and take some preparation of iron. The symptoms, however, were not relieved, and indeed became aggravated by the addition of painful startings of the limb. A bandage was applied round the thigh, above the condyles, having a cord attached to it which passed over a pulley at the foot of the bed, and had a light weight attached at its other extremity. The object of this was to keep the articulating surfaces of the hip from being pressed against each other, and it fully answered the intended purpose, the patient being entirely relieved from pain.

January 13th 1838. The boy was in the following condition. When the limb was rotated inwards, he complained of what he called a shooting pain in the knee and foot. There was no starting of the limb. There was a swelling with evident fluctuation of fluid in the neighbourhood of the hip. The tongue was clean, and the appetite good.

March 26th, 1838. A large abscess was opened on the external and upper part of the thigh, which continued to discharge matter.

April 21st. He had an attack of erysipelas, which extended from the hip downwards on the thigh and upwards on the back, preceded by a rigor, and attended with much constitutional disturbance. The erysipelas subsided, but left him in a weak condition, with a cough and other symptoms of pulmonary disease. On the 16th of May he died.

On examining the body, a large abscess was found occupying the parts in the neighbourhood of the hip, and communicating with the joint. The cartilages of the hip had entirely disappeared. The bones were extensively carious, the head of the femur being much reduced in size, and the acetabulum wider than natural, in consequence of the destruction of its bony margin. A portion of bone was dead, and having been separated from the living bone, lay loose in the articular cavity. On sawing through the remains of the head and the neck of the femur, the bone was found to be apparently less vascular than natural, with yellow cheesy matter in its cancelli.

The foregoing case affords an example of a fact to which I have formerly referred. Where the bones of a joint are in a state of ulceration or caries, it sometimes happens that a portion of such carious bone loses its vitality, and is separated by the usual process of exfoliation, forming what has been called a *sequestrum* in the articular cavity. This may happen whatever the cause of the caries may be. But it is more common in cases of the scrofulous caries than it is in others, probably on account of the lower degree of vitality belonging to the bone in these cases. It is also more common where scrofulous disease affects the joints of the carpus and tarsus, than where it affects the larger articulations. But it is well known that inflammation of bone, which was not previously in a state of caries, or otherwise diseased, may terminate in the death of the bone; and hence necrosis of a joint may

be the result of simple inflammation of the epiphysis in one of the bones of which it is composed. In the limb of a patient which was amputated in St. George's Hospital, I found on dissection the whole of the upper epiphysis of the tibia dead, and in a state of exfoliation, the knee-joint being destroyed in consequence.

In the following case the same thing had occurred in the epiphysis of the lower extremity of the tibia.

Case XLIX.

George Chessall, 22 years of age, was admitted into St. George's Hospital on the 28th of October 1829.

There was a hard swelling in the situation of the lower extremity of one tibia, with considerable redness of the foot and ankle. He experienced great pain in the part, especially at night, when he was frequently roused from his sleep by a sudden and painful starting of the limb. The ankle admitted of the usual motions, and it did not appear that the pain was aggravated by the friction of the articulating surfaces against each other.

The patient stated that eight months ago he had suddenly experienced a violent pain referred to the tibia immediately above the ankle-joint. The pain continued to be very severe during the night, but abated on the following day. He had frequent returns of pain afterwards, and the foot and ankle became swollen.

November 10th. He had a rigor attended with head-ache and vomiting, and followed by a slight degree of fever.

December 25th. An abscess broke immediately above the ankle. A probe introduced into the abscess came in contact with exposed bone.

January 8th, 1830. The synovial membrane of the ankle being much distended with fluid, an opening was made into it through which a considerable quantity of thick pus was discharged.

January 14th. The leg was amputated.

On dissection, the synovial membrane of the ankle was found to be thickened, its inner surface being encrusted with lymph re-

sembling that which forms the lining of a common abscess. There was a small quantity of pus in the joint. The cartilages had completely disappeared.

In the centre of the articulating surface of the tibia a portion of bone measuring about three fourths of an inch in its widest and half an inch in its narrowest diameter, was dead, but still continuous at its margin with the living bone. On making a longitudinal section of the tibia, it was ascertained that the dead bone just mentioned was the base of a sequestrum of a conical shape, nearly two inches in length, which projected into a cavity in the centre of the tibia, containing pus, the exfoliation of the dead bone being complete everywhere except at the lower part.

The death of the whole or of a portion of the articulating extremity of a bone must necessarily cause the immediate destruction of the entire joint. The death of a portion of bone, however small, in the interior of an epiphysis, may, not indeed immediately, but will ultimately, produce the same result. A lady of a delicate habit of body, in walking down a hill suddenly experienced a severe pain in the situation of the ankle-joint. This was followed by inflammation and abscess; but not having seen the patient at the time, I am unacquainted with the particulars of the case. In December 1822, I was consulted respecting her, with Mr. Poyser of Wirksworth, and we agreed in recommending the amputation of the leg. On dissection, after the operation, we found the ankle-joint with abscesses communicating with it, and the cartilaginous surfaces completely destroyed. But the original disease seemed to have been in the centre of the astragalus, where a piece of dead bone, of the size of a horse-bean, lay loose in an ulcerated bony cavity. From this cavity a narrow sinus extended upwards to the superior articulating surface, and communicated with the ankle-joint, by which it was plain that the pus secreted in the ulcerated cavity of the astragalus must have found its way into the articular cavity.

The following is a somewhat more extended history of a case of the same kind.

Case L.

James Goodyer, 9 years of age, was admitted into St. George's Hospital on the 8th of April 1814.

One knee was much enlarged and painful. An abscess presented itself on the anterior lower part of the thigh immediately above the joint. The joint was tender when handled. The leg was partially bent on the thigh.

It was said that he had met with an injury of the knee seven years ago, and that from that time the joint had not appeared to be quite in a sound state, but that he had not suffered much from it until within the last four or five weeks, when the knee became suddenly swollen, with evident pain, so that it was necessary that he should be confined to his bed.

April 20th. An abscess burst on the inside of the knee; and this was followed by some relief from pain.

June 27th. Another abscess burst also on the inside of the knee. Various modes of treatment were tried without any obvious advantage. Sometimes it was supposed that he suffered less; at other times he seemed to suffer more. In the following autumn the limb was amputated.

On dissection of the diseased joint, it was found that the inferior extremity of the femur was much increased in size in consequence of the deposition of new bone on its external surface. On making a section of the femur above the condyles, a cavity was found in the middle of the bone, in which lay a loose piece of dead bone, of the size of a small walnut. A sinus extended from this cavity downwards into that of the knee-joint, communicating with the latter by an opening in the space between the two condyles. There were other sinuses extending from the cavity in the centre of the femur, outwards to the surface of that bone, and communicating with the external abscesses.

Except where the seat of the disease is in the hip or shoulder, necrosis of the articulating extremity of a bone is for the most part easily ascertained, as a probe introduced by one of the sinuses comes plainly in contact with the surface of the dead bone. Circumstances, indeed, may arise, preventing an exact diagnosis; but this is of the less importance, as the condition of the joint otherwise is generally such as to preclude all reasonable expectation of the limb being preserved. The rule is, that in a case of this kind, if the joint is one that admits of being removed by amputation, and the nature of the disease can be clearly ascertained, the patient should be at once advised to submit to the operation; and indeed the only exceptions to the rule are, where the articulating extremities of the phalanges of the toes or fingers, or the heads of the metatarsal or metacarpal bones, are affected in this manner. Here, the joints being superficially situated, the ultimate exfoliation of the dead bone is more easily accomplished. The principal difference, however, is this, that, the joints of the toes and fingers being of a smaller size, diseases of them may exist to a great extent without affecting the general health; and that we have, therefore, ample time afforded to us for bringing the disease to a favourable termination; which we have not, when it is situated in the larger articulations. Much, however, must here depend on the situation of the patient in other respects, and something on the joint in which the disease is situated. In private practice, among the more affluent classes of society, a great deal may be accomplished which cannot be accomplished in hospital practice, or among the poorer classes: and, with persons of all conditions, it may be worth while to submit to a very long-continued inconvenience for the sake of preserving a great toe or a thumb, when it would be otherwise, if the question were about the retaining or losing a little toe or a little finger.

Every practical surgeon is aware how common an occurrence necrosis is in what are called scrofulous children. A slight swelling is perceptible over a bone, which increases, and proves to be an abscess. When the abscess has been opened, or has burst

spontaneously, a probe introduced into it comes in contact with a portion of dead bone, which is slowly undergoing the process of exfoliation. This may happen in any part of the body; and it sometimes happens in the articulating extremities of the bones which I have just mentioned, that is, of the toes or fingers. In such cases the treatment required is very simple; and, where time can be afforded for the cure, it is very effectual. Great attention should be paid to the improvement or maintenance of the general health, and the affected parts should be supported by a stiff leathern splint, so as to keep them in a state of absolute immobility. The mode of applying the splint depends on circumstances. Sometimes it is sufficient to support a part of the hand or a part of the foot; at other times the whole foot or the whole hand must be supported in this manner. Of course the hand is thus rendered useless as long as the splint is worn; but if a splint be nicely adjusted to the foot, and the patient wears over it a cloth boot with a leathern sole, made to be laced in front, no harm will arise from his taking exercise by walking; while it will be productive of great good, as nothing will contribute more than this to the preservation of the general health. If for any reason it should be found that the foot, even thus protected, will not bear the weight of the body, the patient may be provided with a common wooden support, such as is worn after amputation of the leg below the knee. I am aware that what has now been stated, is no more than what has been stated in a former chapter, when the treatment of the scrofulous disease of the joints was under our consideration; but the subject is one of such very great practical importance, that I do not offer any apology for the repetition.

The effect of the application of splints, in these cases of necrosis of the fingers and toes, is sometimes very remarkable. I have seen a child with several fingers enlarged, and variously distorted, and suffering pain on the slightest motion of the hand; in whom, immediately on the splints being applied, all pain has ceased, and in the course of a few weeks the affected parts have become

reduced to their natural size, and have, in a great degree, regained their natural appearance. I have no reason to believe that, where the articulating extremity of the bone has lost its vitality, there is ever any reproduction of bone to supply the place of that which has been separated by exfoliation : and hence it is that if a finger or toe recovers from this disease, it is always shorter than natural. The bone, which remains, however, does not always lose its mobility. A young lady had a disease in the joint of the great toe with the metatarsal bone, there being necrosis of the base of the first phalanx. A splint was applied, and after a very considerable time a portion of dead bone was removed by the forceps, which was found to include the articulating surface. I advised her to continue to wear the splint, presuming that ankylosis would take place. No such result, however, ensued. The toe was considerably shortened ; but whether it was that some kind of new joint was formed, or that there was a production of ligament, which answered something like the purpose of a joint, I will not venture to say ; but from one or the other of these causes the toe was still movable on the metatarsal bone, and nearly as useful as before, enabling the patient to walk and dance without the smallest inconvenience.

In those cases in which the joint is affected in consequence of a portion of dead bone being pent up in a cavity in the articular extremity of the living bone, it is for the most part impossible for the most careful observer to understand the exact nature of the disease, until the death of the patient, or the amputation of the limb, enables him to ascertain it by dissection. Under certain circumstances, however, this difficulty as to diagnosis does not exist ; and a simple operation may then be performed with a great probability of a favourable result.

Case LI.

W. Kendrow was admitted into St. George's Hospital on the 4th of February 1837.

The knee-joint was slightly enlarged.

There was a sinus in the anterior part of the head of the tibia, a little below the joint, through which a probe could be passed into the centre of the epiphysis, where it came in contact with a portion of dead bone, apparently loose in the cavity in which it was contained. The motions of the knee were unimpaired.

From the history which the patient gave, it appeared that about a year ago, he had suffered from a severe attack of inflammation of the head of the tibia, and that some time afterwards an abscess burst in front of the leg, leaving the sinus which has been just mentioned. There had been two or three attacks of inflammation in the interval which had elapsed between the first attack and the time of the patient coming to the hospital.

March 2. Having exposed the head of the tibia, I applied a trephine so as to enlarge the sinus which led to the interior of the bone. At the bottom of this sinus lay a detached piece of dead bone of the size of a horse-bean, but of a very irregular shape. This was extracted without difficulty.

A few days after the operation the patient had an attack of rigor and vomiting, which was followed by a severe attack of erysipelas, of which he ultimately died.

On examining the limb it was found that the whole of the upper extremity of the tibia was increased in size and density, there being a deposit of rough scabrous bone on many parts of its external surface.

The cavity from which the dead bone had been extracted was of sufficient size to contain a large cherry, presenting a tolerably regular concave surface, but without any consolidation of the cancellous structure. This cavity communicated with the knee-joint in front of the spine of the tibia by a narrow aperture. The cartilage covering the head of the tibia was in many parts com-

pletely absorbed, leaving the surface of the bone exposed, but not in a state of caries. In other parts the cartilage was converted into a substance bearing some resemblance to condensed cellular membrane; and in a few places a narrow stripe of cartilage remained, not altered from its natural condition. In some parts the bone, where it was apparently exposed, was found, on a close examination, to be covered by a very thin semi-transparent membrane. There was no pus in the joint.

Although the head of the tibia was hard and dense, the condyles of the femur seemed to contain less earthy matter than under ordinary circumstances. The cartilage covering them was easily peeled off, and some portions of it were so thin, that the colour of the bone could be seen through them.

There is no evident reason why, if he had not been unfortunately cut off by the attack of erysipelas, this patient should not have recovered, retaining a useful joint.

CHAPTER VII.

CHRONIC DISEASE OF THE JOINTS CONNECTED WITH GOUT AND RHEUMATIC GOUT.

SECTION I.

Pathological Observations.

IN the first chapter of this work I have stated that inflammation of the synovial membranes, as it presents itself under ordinary circumstances, may not unfrequently be traced to a gouty diathesis. It is so in numerous instances, in which, nevertheless, neither the patient nor his medical attendant would admit that there had ever been what is called 'a fit of the gout.' I have referred to rheumatism as a cause of inflammation of the synovial membranes in other cases, and I have also adverted to a peculiar disease of a very chronic character, which is generally supposed to bear some relation to both gout and rheumatism, and treated under the name of rheumatic gout. In this disease inflammation of the synovial membrane is the first of a series of changes which the joint undergoes, and which in the course of years ends in its entire disorganisation. I propose to give some account of these changes, of the symptoms by which they are indicated in the living persons, and of the treatment which the disease requires, in the present chapter.

Case LII.

A woman who for many years had suffered from rheumatism, affecting especially the knees, was admitted into St. George's Hospital under the care of Dr. Chambers, on account of a pulmonary disease, from the effects of which she died.

On examining the body after death, the synovial membrane of the right knee was found to be dilated, much thickened, and preternaturally vascular, the inner surface of it being lined by a great number of excrescences, somewhat resembling in appearance the appendices epoplicæ of the great intestine, but of a smaller size. These presented a smooth membranous surface externally, but on being cut into were found to consist of condensed cellular membrane and fat. The cartilage of the external condyle of the femur had wholly disappeared, and in its place a solid bony matter had been deposited, not unlike ivory in colour and consistence. The bone at this part had a grooved appearance, as if worn by the friction of the patella. The cartilage of the inner condyle was altered in structure, being softer than natural, at the same time that it presented an indented or corrugated appearance on its surface. The patella was wholly deprived of cartilage, the exposed surface of the bone being of a hard and compact texture, and exhibiting distinct indications of its having been worn by friction on the external condyle of the femur.

The left knee was diseased nearly in the same manner as the right, and both knees were much enlarged, the enlargement being the result partly of the thickened condition of the synovial membranes, partly of an opaque serum collected in the articular cavities.*

* This case has been formerly referred to, as affording an example of an altered structure of the synovial membrane, consequent on chronic inflammation.

Case LIII.

An old lady who had suffered in an unusual degree from gout, for a great part of her life, was supposed at last to labour under an organic disease of the stomach. She died on the 20th of December 1812, and I was requested to examine the body.

Externally it was observed that several joints of the fingers were ankylosed, the fingers themselves being variously distorted. The middle finger of the left hand was shortened, and the skin over it was loose. The bone of the second phalanx appeared to have been nearly absorbed, so that there were scarcely any remains of it; and only a small quantity of soft substance in its place. The right wrist and elbow were ankylosed, as were also several of the joints of the toes. The knees admitted of incomplete flexion and extension; and the motion of the joints was attended with a grating sensation.

In various parts of the body there were orifices in the skin communicating with membranous cysts, situated in the adipose substance, and discharging a chalky fluid.

On dissection it was ascertained that the pleura pulmonalis and pleura costalis were universally adhering. The peritoneal surfaces of the stomach, spleen, liver, and gall-bladder adhered universally to each other and to the contiguous parts. There were no other preternatural appearances in the thorax and abdomen.

There were no remains of the cartilages in the left knee. The corresponding parts of the patella and condyles of the femur had the appearance of having been worn into grooves and ridges, as if from their friction on each other: presenting, however, a compact surface, the cancellous structure not being exposed, as would have been the case if friction had been carried to the same extent in the dead body. A thin layer of white, chalk-like matter had been deposited on the bones, where the cartilages had disappeared, in several places. On the margin of the articulating surfaces were several small exostoses. The ligaments and synovial membrane

were little altered from their natural state; with this exception, that the thin layer of the latter, which is extended over the cartilages, had disappeared with the cartilages themselves. In the right wrist the first row of the carpal bones were ankylosed to each other and to the radius.

The other joints were not examined.

In the pathological museum of St. George's Hospital there is a preparation exhibiting the condyles of the femur encrusted with a gouty concretion (lithate of soda), taken from a patient, of whose case the following is a brief history.

Case LIV.

A man, 52 years of age, was admitted into the hospital who had long laboured under a disease which had been considered as rheumatic gout. Some time after his admission he was seized with erysipelas of the head, followed by diffuse inflammation of the submucous laryngeal cellular tissue, of which he died.

On examining one of the knee-joints, the synovial membrane was found much thickened and vascular. The cavity of the synovial membrane was filled by a large quantity of a thick white fluid, which proved to be a mixture of lithate of soda and pus. In some parts the cartilages had disappeared, and the exposed surface of bone was covered by a thin layer of the lithate of soda. Where the cartilages remained they were encrusted in the same manner. There were deposits of the same gouty concretion in cysts of the cellular membrane external to the joint.

In the museum of St. George's Hospital there are many other specimens of joints similarly diseased. From these we learn that the lithate of soda is deposited in a variety of textures:—underneath the synovial membrane, on the bone near the margin of the cartilage; on the surface and in the substance of the cartilage;

in the cancelli of the bone, and in the cellular tissue external to the joint. In one preparation of the patella, taken from a gouty subject, the cartilage is seen increased in thickness, and presenting a striated appearance, the striæ being at right angles to the articulating surface. In this case the cartilage is described in the catalogue as having been 'in its recent state softer and more yielding than natural, and having a tendency to break up into fibres.'

Although the opportunities of examining the pathological condition of joints which are affected in this manner are only of occasional occurrence, there is no surgeon of much experience who has not seen many cases of the same disease in the living person, or who, having seen them, will not assent to the correctness of the observation which I have already made, that inflammation of the synovial membrane is the first of the series of changes which the joint undergoes. This is clearly indicated by the symptoms. The deposit of lithate of soda takes place only as the disease advances, and though it is a very frequent, it is not a constant, occurrence. The absence of this deposit is not a proof of the absence of the gouty diathesis. An elderly gentleman was attended by Dr. Chambers and myself, labouring under well-marked symptoms of gouty disease. One of the effects produced was a chronic inflammation of the synovial membrane of one knee. The membrane was considerably thickened, and contained fluid. He had been in this state, sometimes better, sometimes worse, for some years. When living at his house in Scotland, he was seized with symptoms of acute phrenitis, of which he died. The body was examined by his medical attendant, Mr. Johnstone, who found the diseased joint distended with a dark-coloured glairy fluid, and the cartilages absorbed, but without any white incrustation.

Indeed, in cases of gout generally, it is difficult to discover any rule by which the deposit of lithate of soda is regulated. One person has his fingers and toes distorted by gouty concretions, at the same time that deposits of the same kind are found in the larger joints, and in the subcutaneous cellular tissue in various

parts of the body; while another person, who has been equally tormented by the gout with the former, is altogether free from this additional cause of distress. Probably much depends on the greater or less prevalence of soda in the system, the lithate of soda being an insoluble salt, and in this respect differing from the combinations of the lithic acid with the other alkalies. There is great reason to believe that many of those who are troubled with what are commonly called chalk-stones have much aggravated, if they have not actually produced, the evil, by taking large quantities of soda for the purpose of correcting acidity of the stomach.

The process by which the absorption of the harder textures takes place in these cases is manifestly very different from ulceration, and is altogether very remarkable. The cartilages disappear, so that the bones are exposed; but the latter present nothing corresponding to the appearance of a carious surface. They bear evident marks of having been subjected to the influence of friction, appearing as if portions of their surface had been scraped off by a chisel. This is especially observable in the knee, where the motions of the joint are only in one direction and less observable in the hip, where the motions are more various. But the results of friction on the living are very different from what they would be in the dead bone. There is no exposure of the cancellous structure; a process of repair goes on simultaneously with that of destruction, and the consequence is a formation of a hard and compact layer of bone, bearing no small resemblance to ivory, covering the cancellous structure, which must have been exposed otherwise.

In one of the cases which have been just described, it was found that some new formations of bone, in the shape of small exostoses, had taken place at the margin of the articulating surfaces. I shall have occasion hereafter to refer to two other cases in each of which portions of such newly-formed bone had been broken off by the motion of the joint, and become loose bodies in the articular cavity. In other cases masses of new bone are laid on in one part, while the original bone is removed by absorption

in another, so as completely to alter the form and character of the articulating surfaces.

Section II.

On the Symptoms of this Disease.

The individuals who are most liable to be thus affected by rheumatic gout are those who have not been accustomed to much bodily exercise, and have at the same time led luxurious lives. I suspect that too great an indulgence in the use of animal food is even more likely to produce it than the free use of fermented or spirituous liquors; and that it is for this reason that it is frequently met with among porters and the upper servants of wealthy families.

The disease is rarely confined to a single joint, and in most instances several joints are affected in succession. Often it shows itself in the first instance in a joint of one of the fingers, which is observed to be slightly enlarged and stiff, with an occasional twinge of pain in it. Then, one after the other, other joints of the fingers are affected in the same manner. It was to this enlargement of the joints of the fingers that Dr. Haygarth gave the name of *nodosities*. The immediate cause of it seems to be a thickening of the synovial membrane, and probably in part an effusion of serum into its cavity. Afterwards the disease extends to the other and larger joints, sometimes to a greater, sometimes to a smaller number in succession. In those joints which are superficially situated, so as to admit of examination, fluid may be detected, the quantity of which, however, varies accordingly as the limb is exercised or kept quiet, and is seldom very large. The fluid is more perceptible in the first instance than it is afterwards, on account of the synovial membrane becoming thickened.

The progress of the disease is generally very slow, so that many years may elapse before it reaches what may be regarded as its most advanced stage. Throughout the whole of its course it

causes no severe pain; but there are constant uneasy sensations, and much distress and inconvenience, in consequence of the joints becoming gradually more rigid and unfit for use. The patient, in addition to his local ailments, always suffers, in a greater or less degree, from the usual effects of dyspepsia, which are aggravated by want of exercise. He is liable to acidity of the stomach and flatulence after his meals; is nervous and irritable; and every error as to diet, as well as all mental excitement, will produce an aggravation of both the constitutional and local symptoms.

In a few instances, after having reached a certain point, the disease becomes stationary, or there may be apparently some degree of improvement. But except where it was treated in the very earliest stage, I do not recollect any one case in which there was anything approaching to a cure. In the majority of cases the disease is progressive, the joints becoming more and more disorganised, sometimes with little, at other times with much, increase in size. That increase in this stage of the disease depends not merely on the causes already mentioned, but also on a deposit of new bone in the neighbourhood, and sometimes on that of a gouty concretion in the surrounding cellular tissue. Ankylosis sometimes takes place as an ultimate result. There is little tendency to suppuration, I cannot say that abscess never forms; for I suppose that there are no morbid changes of any kind in the course of which this may not possibly occur; and indeed, in one of the cases which I have just recorded, it was believed that there were pus-globules mixed with the semifluid substance which the joint contained. But the formation of abscess in these cases certainly does not belong to the regular order of events, and must be regarded as a rare exception to the general rule. This is a remarkable circumstance in the history of the disease, and forms an important difference between it and the ordinary diseases to which the joints are liable.

Distressing as such a malady must always be, harassing the patient, as it does year after year, with no prospect of a cure, still it is an evil varying very much in degree in different instances.

In one individual a few joints only are affected, and these not to such an extent as to prevent him from taking a certain amount of exercise, and enjoying the advantages of social intercourse; in another scarcely one joint of the extremities remains in a sound state: some are completely ankylosed, and others are so stiff as to be nearly useless. Nevertheless, the patient thus afflicted, a cripple, dependent on others for the means of locomotion, may live for years, reconciled to calamities which have gradually come upon him, and in the possession of a certain amount of comfort amid all his sufferings.

Section III.

On the Treatment of this Disease.

In the very commencement of this disease, before any actual disorganisation has taken place, and while the joints affected are limited in number, I believe that much may be done towards preventing its further progress. The patient should be placed on a careful system of diet, partaking very moderately of animal food, avoiding fruits, acids, raw vegetables, and sugar, and taking little or no fermented or spirituous liquors. He should take exercise daily, so as to induce perspiration; and if this cannot be readily accomplished, he may with great advantage once in a week or fortnight make use of the hot-air bath. In addition to such careful management of himself, he may from time to time take alterative doses of the acetic extract of colchicum, combined with a small quantity of the mercurial pill, and occasional purgatives. Moderate doses of potash or magnesia may be given three or four hours after each of his principal meals, so as to neutralise any superabundant acid in the stomach. Soda should be carefully avoided, as tending, by its combination with the lithic acid, to form gouty concretions.

According to circumstances, however, the treatment may be varied. Thus when the patient is depressed, as sometimes

happens by the use of colchicum, the mixture composed of rhubarb, magnesia, and ginger, sold under the name of 'Dr Gregory's Powder,' may be taken every night, with an active aperient at stated intervals; and very great benefit will often be obtained from a very long perseverance in the use of these simple remedies.

Little is to be done by local applications. If, however, there be more than usual pain in a joint, leeches may be applied, and on particular occasions a bandage, not for the purpose of making pressure, but of limiting motion. In some instances a light leathern splint, or pair of splints, may be employed with advantage.

When the disease is fully established, the same kind of treatment will be useful in mitigating its symptoms, and sometimes in retarding its progress. But here the more active remedies, such as mercury and colchicum, must be reserved for special occasions. The iodide of potassium has the reputation of being useful in cases of this description; and I believe that its reputation is not wholly undeserved. It should be given only in small doses of two or three grains twice daily, but taken, if it agrees with the patient, for several weeks at a time.

But, after all, no general rule can be laid down as a guide for the practitioner on all occasions. Each individual case forms a study in itself, not only for the medical attendant, but for the patient also.

In one case, in which the patient was afflicted with this disease in a very aggravated form (so many joints being affected, that she lay almost helpless on a sofa, and various methods of treatment having been already employed to no purpose), having learned that cod-liver oil had been formerly supposed to be useful in some forms of rheumatism, I was tempted to prescribe this remedy for her. The purified oil was administered internally, and at the same time rubbed in as a liniment on the affected joints. It was a mere experiment; but there is certainly great reason to believe that it was not altogether unsuccessful. Not only did the disease cease to make progress, but, when I last saw the patient, after she had taken and rubbed in the oil, with occasional intermissions,

during a period of seven or eight months, there was a distinct and manifest improvement as to all the symptoms. Indeed the result was such, that to any other patient, under the same combination of circumstances, I shall certainly be disposed to recommend a trial of the same remedy.

In the sixth volume of the 'Dublin Journal of Medical Science,' Dr. Smith, of Dublin, has given an account of a disease of the hip-joint, under the name of morbus coxæ senilis. It has been since described by Mr. Adams, and again by Dr. Smith (in a volume full of interesting practical observations), under the name of chronic rheumatic arthritis of the hip-joint. Now on comparing the cases adduced by Dr. Smith with those which have occurred under my own observation, I can come to no other conclusion than that the disease which he has so graphically described, belongs to the same class with those which form the subject of the present chapter; and that, if the opportunity had occurred of examining the morbid appearances in the very beginning of the disease, he would have found them limited to the synovial membrane. At the same time I am by no means satisfied that this remark can properly be applied to all the cases which are represented by the drawings with which Dr. Smith's volume is illustrated. Some of the femora which are there represented have a similar appearance to what I have repeatedly observed in long-standing cases of ulceration of the cartilages and scrofulous diseases of the hip, with the particulars of which I had been acquainted during the lives of the patients. That a disease, apparently so simple in its origin, should ultimately cause such vast and peculiar changes in the structure of a joint, can be deemed in no wise remarkable, if we consider how, in other cases, one diseased action leads on to another, and how diseased actions of all kinds are modified as to the effects which they produce by peculiarities of health and constitution.

CHAPTER VIII.

ON LOOSE CARTILAGES AND EXCRESCENCES IN THE CAVITIES OF THE JOINTS.

In a former chapter I have described certain excrescences from the inner surface of the synovial, which appear to be the result of long-continued inflammation. There are other excrescences, which cannot be traced to inflammatory action, and which at the same time are no more of a malignant nature than the common polypi of the nose or uterus: and of these I propose to give some account in the present chapter.

A patient complains that occasionally in walking he is seized with a sudden pain in the knee, the leg at the same time being fixed at a particular angle. With more or less difficulty he contrives to regain the mobility of the leg; and when he has done so he discovers a hard solid body lying generally by the side of the patella, on one of the condyles of the femur: or perhaps this solid body is not detected at the time, but accidentally discovered afterwards. There can be no doubt that in such a case the symptoms are best explained by supposing that the solid body in question is movable in the joint, and that it occasionally slips in between the articulating surfaces. If a surgeon makes an incision into the joint, and extracts the movable body, he finds it to present externally all the appearances of cartilage, being smooth on its surface, flattened, and of an irregular form otherwise. If it be of a small size, on being cut into it is found to be cartilaginous throughout. But if it be larger (of the size of a garden bean, for example) there is always a deposit of earthy matter (phosphate of lime) in the centre: and if under these last-mentioned circumstances it be

dried, the shrinking of the cartilage causes it to have the appearance of an irregularly shaped bone.

Such loose cartilages in the joints, but more especially in the knee-joints, are not uncommon; and the question arises—how are they produced? Some have even supposed that they have a kind of independent existence, bearing some relation to hydatids or other parasitic animals. The researches of pathology, however, contradict this hypothesis. A cartilage of this kind is originally formed in connection with the synovial membrane. As it increases in size, it projects into the cavity of the joint, but is still attached to the synovial membrane by a membranous band, which is continuous at one extremity with the synovial membrane itself, and reflected over the newly-formed body at the other. After some time, the membranous attachment having become elongated, and the cartilage having attained a larger size, the former gives way, and the latter become a loose body, slipping from one part of the joint to another, and interfering with its motions. Sometimes there is only one of these loose bodies in a joint, but frequently there are two or more, and occasionally they are still more numerous.

These remarkable formations are not peculiar to the joints. They are met with, though more rarely, in the tunica vaginalis of the testicle, in the pericardium, in the pleura, and in the peritonæum. The only serous membrane in which (as far as I know) they never occur is the tunica arachnoides. The structure and formations of the serous are so analogous to those of the synovial membranes, that it can be no matter of surprise that they should, to a considerable extent, be liable to similar diseases.

In a preparation in the Pathological Museum of St. George's Hospital, these substances are seen in the various stages of their progress. There are seven of them in all. Some are attached to the synovial membrane covering the crucial ligaments; others are situated elsewhere. The smaller ones are seen to have been developed on the external surface of the synovial membrane, in contact with the subsynovial cellular tissue. Those of a larger

size project into the cavity of the joint, but are still attached to its inner surface by membranous bands. The largest of all contain bony matter in the centre; the others are cartilaginous throughout.

A loose cartilage may exist in a joint without causing much inconvenience. So it is when it is permanently situated near the inner or outer condyle of the femur, and does not slip in between the articulating surfaces. In other cases, when the patient is walking, he is seized quite unawares by a pain in the knee, more or less severe. The leg becomes fixed at a particular angle, so that he is unable to proceed further. Generally he discovers some method by which he is enabled himself to dislodge the cartilage from the place into which it has slipped. This is done by certain movements of the leg, and by percussion of both sides or one side of the joint. But even then the accident is often followed by inflammation of the synovial membrane, which may continue for several days, or sometimes for three or four weeks.

Nor is this the whole extent of the evil. Ultimately, where the loose bodies have long existed, the articular cartilages are found in spots to have degenerated into the fibrous structure, which has been formerly described; while in other parts they are entirely absorbed. In one case, in which I had the opportunity of examining the parts by dissection, besides some loose cartilages having the usual appearance, I found another loose body of an irregular shape, with one surface smooth and cartilaginous, and the other surface having a thin layer of bone adhering to it, being evidently a portion of the articular surface actually broken off from the head of the tibia. That such an accident should occasionally happen, from any sudden and violent motion of the joint, with a hard body loose in its cavity, is no more than might reasonably be expected.

It has been already stated that in some instances loose cartilage may exist in a joint, causing little or no inconvenience. Still even here the patient is never safe. It may quit the situation in which it is lodged (perhaps in consequence of the breaking of the

membranous band, by which it remained attached to the synovial membrane), and then all at once he may begin to suffer. As a matter of precaution, it is always advisable that a bandage should be worn, which will have the effect of limiting the motions of the joint, and which may possibly do even more than this by causing the loose cartilage to become permanently fixed in some part of the joint where it cannot interfere with its motions. The bandage described formerly, at page 153, is a very convenient one for these purposes.

If the bandage should not give the desired relief, and the patient suffers much inconvenience from the complaint, there is no remedy but the removal of the cartilage or cartilages by an incision into the joint.

My own experience is in favour of this operation, provided that it be done in a cautious and prudent manner. The patient should be kept in a state of the most perfect quietude for two or three days preceding, and for several days after, the operation. The cartilage having been well fixed, the different parts over it should be slowly and separately divided until it is exposed. The wound of the synovial membrane may be dilated by means of a probe-pointed bistoury, until it is of sufficient size to allow of the cartilage being extracted with a tenaculum; and the cut edges of the skin should be instantly replaced in exact contact with each other and secured by means of adhesive plaster. There should be no searching for the cartilage in the joint. If it should slip out of the way, the wound should be immediately closed, and the limb should be laid upon a splint, until the cut edges are firmly united, —the completion of the operation being postponed to a future opportunity.

I attended a gentleman who laboured under this troublesome disease, and in whom the loose bodies not unfrequently slipped between the articulating surfaces of the knee, occasioning an almost immediate swelling of the joint, with the most excruciating pain and tenderness, and much symptomatic fever. In one instance more than a month elapsed before these symptoms had

subsided. These circumstances are noticed, because they prove that, in this patient, there was a considerable disposition to inflammation; yet, by attending to the precautions above mentioned, as many as five loose cartilages were extracted by three different operations without the slightest inconvenience arising from any one of them.

I was consulted concerning a case in which Mr. Liston, with my concurrence, removed two large loose cartilages from a gentleman's knee, by a subcutaneous operation puncturing the skin, and then making a free division of the fascia and synovial membrane with a narrow bistoury, similar to that which is used in the subcutaneous division of tendons. The operation in this instance was perfectly successful. My own experience, however, does not enable me to determine whether it has or has not any advantage over that which is commonly performed.

I have seen two cases in which loose bodies existed in a joint, which were of a different nature, and had a different origin, from those which are commonly met with. In cases in which a joint has been long the seat of disease (especially of that which I have described under the name of rheumatic gout), it occasionally happens that a bony ridge is formed, like a small exostosis, round the margin of the articular surfaces. In the two cases to which I allude, this preternatural growth of bone had taken place, and, in consequence of the motion of the parts on each other, portions of it had been been broken off, and lay loose in the cavity of the joint.

The two following cases are examples of fleshy tumours growing from the inner surface of the synovial membrane, and successfully removed by an operation. They are the only cases of the kind which have come under my observation, and therefore contain all the knowledge I possess on the subject. Of the first of these patients I have heard nothing since he quitted the hospital. The second has never had any return of the disease in the twenty-seven years which have elapsed since the operation was performed.

Case LV.

Morris Sudbury, 21 years of age, was admitted into St. George's Hospital on the 4th of October 1820.

He had swelling, and complained of pain and tenderness, of one knee. He was kept in bed; the joint was bathed with a cold lotion. Afterwards blisters were applied. The swelling subsided, but the joint continued weak and painful.

On the 11th of December, for the first time, a tumour was discovered evidently within the cavity of the knee-joint, situated on the edge of the patella, over the external condyle of the femur. The tumour appeared like a loose cartilage, of about the size and form of an almond. When the man attempted to walk, in certain motions of the limb, it slipped into the cavity of the joint, producing considerable distress, and making him lame. An attempt was made to confine it by means of bandages, but without success.

On the 5th of January 1821, Mr. Ewbank made an incision through the skin, fascia, and synovial membrane, so as to expose the tumour. It was found to be not cartilaginous, but of a gristly structure; of about the length of an almond, but rather broader; and it was attached by one extremity to the synovial membrane, near the edge of the patella. This attachment having been divided, the tumour was removed. The edges of the wound were brought into contact, and united by the first intention. Some inflammation of the joint followed, but was subdued without much difficulty. When the patient began to walk, he found himself to have been much relieved by the operation.

Six weeks afterwards, however, a tumour was discovered in the knee of a smaller size than that which had been removed, but occupying precisely the same situation; so that there was sufficient reason to believe that it had grown from the same basis. This tumour could be pressed into the joint by the fingers, but did not slip into it spontaneously in walking; and therefore, at the time when the man left the hospital, he did not suffer any inconvenience from it.

Case LVI.

Mr. H., a young man, consulted me on the 25th of April 1822, labouring under the following symptoms:—In certain motions of the right knee a tumour presented itself on the inside of the patella, which had been supposed to be, and still had the appearance of being, a loose cartilage of a large size. He said that occasionally, in walking, this substance slipped between the articulating surfaces. The accident always produced considerable pain at the time, and inflammation of the synovial membrane afterwards, which in one instance confined him to his bed for several weeks. He said further, that these symptoms had been gradually coming on for two or three years; that he had worn bandages, without experiencing any good effect; and that, as the disease interfered very much with his comfort and occupations, he was desirous of submitting to any operation which afforded him a prospect of relief.

On the 28th of April, after he had remained for one or two days in a state of perfect quietude, I carefully made an incision on the tumour, which had been previously fixed by the finger of an assistant over the inner condyle of the femur. When it was thus exposed, I found it to be, not a loose cartilage, but a tumour of a fleshy structure; and that it was connected to the synovial membrane, below the patella, by a broad adhesion. Having divided this adhesion, I removed the tumour. The edges of the wound were brought together by means of a suture passed through the integuments, and stripes of adhesive plaster. The patient was kept in bed, and the limb was supported by a splint, to which it was secured by bandages in such a way as to render the joint quite incapable of motion.

About twenty-two hours after the operation, symptoms of violent inflammation began to show themselves. There was almost insupportable pain; the joint became rapidly swollen; the pulse rose to 90 in a minute, and was hard and strong. By means of very active antiphlogistic treatment, however, the inflammation

subsided, without producing any bad consequences. On the 27th of June he was able to undertake a journey a considerable distance from London; at which time the knee was neither swollen nor painful, but it was still incapable of perfect flexion and extension. Since then the patient has recovered the perfect use of the joint.

On examining more accurately the tumour which had been removed in this case, it was found to be about two inches and a half in length, and one inch and a half in breadth, and somewhat less than half an inch in thickness in the thickest part; convex on one surface, and somewhat flattened on the other. It was of a firm, fleshy structure. The general appearance of it a good deal resembled that of the coagulum which is found in the sac of aneurism; but it was not laminated: it had a smooth membranous surface; and it was manifestly organised, as vessels might be distinctly traced ramifying through its substance.*

In each of these cases the operation was resorted to under the impression that the substance contained in the cavity of the joint was one of the loose cartilages of which I have spoken in the beginning of this chapter. If I had been acquainted with the real nature of the disease in the last case, I should certainly have been less inclined to attempt its extirpation; and the violence of the inflammation which ensued must form an additional reason for hesitation in any future case of the same kind.

But the question will arise, how are such firm fleshy tumours,

* A remarkable circumstance occurred in the progress of this case. The wound made in the operation united by the first intention; but the joint being much distended with synovia, the adhesion gave way; so that the wound was re-opened on the ninth or tenth day, and the synovia escaped in a small but constant stream. The discharge of synovia continued; but the joint being carefully retained in a state of the most perfect quietude, supported on a splint, no additional inflammation was the consequence. At last the flow of synovia ceased; the wound gradually closed, and in the course of three or four weeks was firmly cicatrised. The same thing happened, under my observation, in another case, after the removal of a loose cartilage from the knee.

which are capable of altering their position in the cavity of a joint, and which produce symptoms similar to those which are produced by loose cartilages, to be distinguished from the latter? Perhaps, being aware of the possibility of the existence of a tumour of this description, we may, by a very careful examination, be enabled to ascertain, even through the superjacent soft parts, that it has not the same degree of hardness with cartilage itself. I am not at present acquainted with any other circumstances on which our diagnosis can be founded. Fortunately, however, it happens that, while loose cartilages in joints are not uncommon, such fleshy tumours as I have just described are of very rare occurrence.

Among the valuable essays illustrative of practical surgery, published by the late Mr. Hey of Leeds, there is one in which he gives an account of certain cases in which he supposed the patients to have suffered from what he has termed an internal derangement of the knee-joint. These cases, affecting as they do, not indeed the life, but the comfort of the individual, are well deserving the attention of the surgeon; and for reasons which will presently be apparent, I am led to believe that the consideration of them can nowhere be more properly introduced than in connection with that disease which forms the subject of the present chapter.

The patient, in using the limb, suddenly finds the leg fixed at an angle to the thigh, with more or less pain. By making a more complete flexion, and then a sudden extension of the leg, or by some other management, the mobility of the joint is restored. The accident however recurs, sometimes at longer, sometimes at shorter intervals, and this state of things may go on for years. In one case the restoration of the joint to its natural condition is accomplished easily; in another with difficulty; and according to circumstances which we cannot explain, the accident is followed by much or little inflammation, or by no inflammation at all.

I am not aware that any examination has been made of a joint liable to these affections, so as to afford us any certain evidence as to the peculiar condition of it on which the symptoms depend. It is difficult to understand how there should be any actual displacement of parts so fixed by their attachments as the crucial ligaments or the semilunar cartilages. The symptoms very much resemble those produced by a loose cartilage within the joint. But in the cases here referred to, no loose cartilage can be detected. However, it may well be that there is a loose cartilage, or some kind of pendulous excrescence, which occasionally slips into the space between the articulating extremities of the bone, though it is never so situated as to be perceptible externally; and this on the whole seems to be the most probable hypothesis. Still it must be owned that the subject is open to further inquiry, and that the facts which I am about to state are not very easily to be reconciled, either with this hypothesis, or with that suggested by Mr. Hey. A medical practitioner, at the western end of London, occasionally found his leg fixed at an angle to the thigh in the manner which has been described. By experience he had learnt the management of his own case, and by certain motions of the limb contrived to relieve himself whenever the accident occurred. One day, however, he failed in doing so. He was in consequence seen by the late Mr. Vance, afterwards by myself, and then by Sir Astley Cooper; but we were all equally unsuccessful with himself; and after having made various attempts to extricate the leg from the position in which it had become fixed, and caused the patient to suffer much pain to no purpose, we were compelled to leave him in the situation in which we found him. Much inflammation of the joint followed, which was relieved by the usual remedies. After some weeks (having no written notes of the case, I do not know the exact period) the patient found that the joint had acquired a small degree of mobility. This gradually increased, and at last he regained the perfect use of the limb; could bend and extend the leg, and walk as well as ever. For a considerable time afterwards,

during which I occasionally saw him, he had no recurrence of the accident. In the meanwhile he became affected with some organic visceral disease, which compelled him to leave London. Ultimately he died, and I have not heard that the condition of the joint was made the subject of examination after death.

CHAPTER IX.

MALIGNANT DISEASES, AND OTHER MORBID GROWTHS, CONNECTED WITH THE JOINTS.

It is well known that the bones are liable to be affected with carcinoma. To that cause are to be attributed the pains in the limbs which sometimes occur in patients who suffer from carcinoma of the breast, and which are often so intense as not to admit of being relieved even by the most powerful opiates. In such cases the bones become so brittle, that they may be fractured by the slightest force, even by the patient accidentally turning himself in bed.

If the articulating extremity of a bone be thus affected, the symptoms which arise will more or less resemble those produced by other diseases of the joint.

Case LVII.

A lady between 60 and 70 years of age, in the year 1817, underwent the operation for the removal of a scirrhous breast. Some time afterwards a hard tumour showed itself in the cicatrix; and, about the same period, she began to complain of pain in the left hip and thigh. On the 7th of November 1820, I saw her in consultation with Mr. Smith, surgeon, of Richmond, by whom she was attended. At this time a large scirrhous tumour occupied the situation of the breast which had been amputated. She complained of pain in the hip, thigh, and knee, which was aggravated by pressure. The pain was very severe, keeping her awake at night, except when she was under the influence of a very large dose of opium. There was a cluster of enlarged glands in the groin, making

a hard, and somewhat movable tumour. On the 18th of December following the patient died; and the body was examined by Mr. Smith and myself on the following day.

We found that the thigh-bone had been broken transversely about two inches below the neck; and it was evident, from the appearance of the fracture, that it had taken place either immediately before or after death. In either case, it must have been the result of some very trifling accident. The whole of the superior extremity of the thigh-bone was softer and more brittle than natural; but this morbid change was less distinct below than above the fracture, and it was most distinct in that part of the head of the bone which was contiguous to the cartilage. On making a section of the head and neck of the femur, the earthy matter was found to be very deficient, and a cartilaginous or gristly substance was seen blended with the bony structure. In several places there were spots of increased vascularity, with a deposition of some cheesy matter in the centre. The cartilages were not ulcerated, and there was no effusion of pus, lymph, or serum into the cavity of the joint. The enlarged inguinal glands had the structure of scirrhus; and there was a similar mass of scirrhous lymphatic glands in the pelvis immediately above the crural arch.

The bones are much more liable to be affected by fungus hæmatodes than they are by carcinoma; and the former frequently occurs in them as a primary disease; that is, not having previously shown itself in any other part of the body. Several cases have fallen under my observation, in which a tumour of this description has had its origin in one of the bones of a joint; and it is evident that such a tumour, affecting in its progress the contiguous parts, must, by degrees, completely destroy the structure of the joint.

According to my experience, it is very difficult in these cases to recognise the exact nature of the disease until it has made considerable progress. Very frequently, while in its early stage, is

causes the patient so little inconvenience, that he scarcely thinks it worth while to seek surgical advice. After some time a dull pain is experienced in the joint, which is somewhat aggravated by exercise, and the increase of size is too palpable to be overlooked. As the tumour increases, it is found to be elastic in some parts, and probably hard in others. For a considerable time it does not interfere with the functions of the joint, which, however, afterwards becomes limited in its motion, and ultimately completely fixed in one position. I have known only a single case in which the patient did not submit to amputation before the disease had reached its most advanced stage; and here the skin became ulcerated, and a large ill-conditioned ulcer was the consequence.

The two following cases will sufficiently illustrate the foregoing observations.

Case LVIII.

William Williamson, 14 years of age, was admitted into St. George's Hospital on the 21st of September 1831, on account of a tumour on the inside of the right knee, extending from about two inches below the tubercle of the tibia upward, over the inner condyle of the femur, as high as one-fourth of that bone, and backward so as to occupy the ham. The boundaries of the tumour were distinctly defined. It seemed to have had its origin in the head of the tibia, and the tendons of the inner ham-string were seen stretched over its surface at the upper part, and apparently terminating in it below. The circumference of the knee-joint, in the situation of the tumour, was eighteen inches. The skin covering the tumour was tense and shining, with large tortuous veins ramifying into it.

On examining it with the hand, some parts of the tumour were found to be hard, while others were soft and elastic.

The joint admitted of some degree of motion, but was kept in the half-bent position. The tibia appeared to be the only bone implicated in the disease.

The patient had, generally, had good health, and seemed to be

free from all other disease at the time of his being admitted into the hospital.

He stated that in April 1831 he first experienced a slight degree of pain in the head of the tibia, especially in walking. About six weeks afterwards he observed a slight enlargement of the bone, which from that time gradually increased.

September 29th. The limb was amputated.

On examining the knee-joint, the tumour was found to be wholly formed by an expansion of the head of the tibia. The upper and inner part of the tumour was composed, partly of cysts containing a bloody fluid, and partly of organised medullary substance. In other parts there was a mass of bony and cartilaginous substance, disposed in fibres which seemed to proceed from what had been the surface of the original bone, and presented a somewhat radiated appearance. The other bones, the cartilages, and the soft parts composing the joint, were in a natural state.

Case LIX.

Louisa Burton, a girl of a delicate habit, was admitted into St. George's Hospital on the 2nd of March 1836. She stated that she had been out of health for some time, and, for the last fifteen months, had experienced shooting pain in the right shoulder, gradually increasing in severity.

At the time of her admission there appeared to be some enlargement in the situation of the upper extremity of the humerus. She complained of pain when the head of the humerus was pressed against the surface of the glenoid cavity of the scapula, but not when, by placing the hand on the elbow, pressure was made in the direction upwards. Pain was also occasioned by raising the elbow, so that the limb should form a right angle with the body.

An issue was made with caustic behind the shoulder, and a mercurial treatment was employed. It was supposed at the time that some improvement had taken place, but the patient left the hospital on the 30th of May, as the air of it did not agree with her general health.

On the 18th of January 1837, she was readmitted into the hospital. She was now in a better state as to her general health, but there was a visible increase in the size of the head of the humerus. She complained of severe pain when pressure was made on this part, but she had little pain otherwise.

Soon after her admission she had a severe attack of erysipelas, under which she sank and died.

On examinng the body, the synovial membrane and capsular ligament of the shoulder-joint were found to be free from disease. The cartilage lining the glenoid cavity of the scapula was in a natural state. The cartilage covering the head of the humerus was much attenuated, and was easily separated from the bone. In some parts it was nearly transparent, and had the appearance of membrane rather than of cartilage.

Immediately underneath the cartilage the bone had disappeared, and in its place there was a soft organised mass, of a reddish colour, elastic to the touch, resembling a medullary tumour, but of a firmer consistence than is usual. At the posterior part of the humerus, below the greater tuberosity, there was a protrusion of the same morbid growth of the size of a small chestnut. On the inside of the neck of the humerus, and in the upper part of the shaft of the bone, the vascular substance already mentioned was continued into a more dense structure, approaching to the consistence of cartilage, and very similar to scirrhus in appearance.

I have no reason to believe that any truly malignant disease ever has its origin in the synovial membrane. At any rate such an occurrence must be rare, as no example of it has fallen under my own observation. It appears, however, that the same exemption does not extend to the fibrous structures; as in the pathological museum of St. George's Hospital there is a preparation taken from a patient under the care of Mr. Cæsar Hawkins, in which a large fungous tumour, connected with the knee-joint, seems to have had its origin from the loose edge of the patella

and the ligament of the patella. In this case, notwithstanding the existence of some enlarged glands in the groin, the limb was amputated. The patient died very soon afterwards, labouring under visceral disease.

It is plain that whether the malignant disease affecting a joint be scirrhus or fungus hæmatodes, or partaking of the nature of both the one and the other, the surgeon has nothing to offer in the way of remedy but amputation; and the only question is, how far is it probable that even this will lead to the patient's cure? I am afraid that there is no one who has had much experience in these matters who can feel himself justified in entertaining any sanguine hopes of the ultimate success of an operation performed under these circumstances. There is no doubt that, in the great majority of instances where we have the opportunity of tracing the patient's history afterwards, we find that the disease has returned either in the limb itself, or in some of the viscera. In a very few cases, however, it is otherwise.

Case LX.

In June 1836 I was consulted respecting a young lady, about 18 years of age, who laboured under a considerable enlargement of one shoulder. The head of the humerus was expanded into a broad and somewhat elastic tumour. There was some but not considerable pain in the joint. The mobility of spine was necessarily impaired by the increased size of the humerus, but did not seem to be affected otherwise.

In a consultation between Sir Astley Cooper and myself, it was agreed that the limb should be removed at the shoulder-joint, which operation I afterwards performed in the presence of Sir Astley Cooper and Mr. Aston Key.

The scapula, the cartilage lining the glenoid cavity, the capsular ligament, and synovial membrane of the joint, were in a healthy state. The disease was wholly confined to the head of the humerus, which was converted into a medullary or fungous tumour of considerable size, with very little remains of earthy material in it.

The cartilage remained entire, adhering to the surface of the morbid growth.

The wound healed readily, and I know that there had been no return of the disease two years afterwards. I have heard nothing of the patient since that period.

It is to be observed that in this instance the whole of the humerus, that is, the whole of the organ in which the disease was situated, was removed. It is probable that the success of the operation in such cases depends mainly on that circumstance. When a scirrhous tumour is imbedded in the gland of the breast, no experienced surgeon would be satisfied with any operation short of that of removing the entire breast, and the impossibility of doing more than to remove a portion of the tongue, affords a reasonable explanation of the almost universal failure of an operation when that organ is the seat of malignant disease.

Are we, then, to conclude that, when a joint is affected by malignant disease, it is never advisable to amputate the limb, unless the whole of the bone in which the disease exists can be taken away? For example, that we are justified in recommending the amputation of the thigh, if the disease be limited to the head of the tibia, but not if it be in the condyles of the femur? The question is of great practical importance, and deserves further consideration.

Case LXI.

Mr. O., 25 years of age, in January 1828, first experienced a sensation of weakness in the right knee, with a slight pain, after walking even a short distance. These symptoms continued; and, in the course of two or three months, he observed a small tumour over the external condyle. He remained in this state, the tumour not increasing in size through the spring, and the greater part of the summer.

In the middle of the following August he one day went through

a great deal of fatigue in grouse-shooting; after which the tumour began to increase in size.

On the 1st of September, in walking over a field, his foot slipped into a hollow in the ground. This caused great pain in the knee, and he was under the necessity of riding home. After this accident the tumour progressively increased. On the 25th of January 1829, he came to London, and placed himself under the care of Mr. Griffiths, of Pimlico, and myself. At this time there was a very considerable enlargement of the whole of the upper part of the knee-joint, so that it was four inches more in circumference than the corresponding part of the opposite limb. The tumour was soft and elastic, occupying the situation of both condyles of the femur, but being more especially prominent in that of the outer condyle. The head of the tibia and the patella did not seem to be implicated in the disease, and the joint retained nearly its natural degree of mobility.

For some time after I was consulted, the tumour remained nearly stationary: then it began to increase; and, as no remedy seemed to have any dominion over the disease, a consultation was held with Sir Astley Cooper, in which it was determined that the limb should be amputated. The operation was accordingly performed on the 6th of July 1829.

On examining the limb afterwards, the femur was found to terminate abruptly about five inches above the knee-joint. In place of the condyles and lower part of the shaft of that bone, there was a large tumour, of an irregular form, the structure of which *bore a nearer resemblance to that of fungus hæmatodes than of any other morbid growth.* The cartilage which had covered the surface of the condyles of the femur was seen expanded over the lower part of the tumour; being everywhere thinner than natural, but nowhere in a state of ulceration. In some parts it had contracted adhesions to the cartilage covering the head of the tibia.

In other parts the tumour was covered by some thin remains of the periosteum, and a layer of thickened cellular membrane.

I heard of this patient being alive and well, having had no occurrence of the disease some years after the operation.

I have transcribed the above history from the notes of the case which were taken at the time, and which were afterwards published in the third and fourth editions of the present work. It may be observed that the structure of the tumour is described *not as being that of fungus hæmatodes, but as bearing a nearer resemblance to it than to that of any other morbid growth.* It would appear, therefore, that I must, in the first instance. have entertained some doubts as to the exact nature of the disease. To whatever extent these doubts existed, subsequent observations have satisfied me that they were not without foundation, and have, indeed, led me to the conclusion that the disease was not fungus hæmatodes, but a peculiar change in the structure of the femur, of local origin, and not, in the proper acceptation of the term, of a malignant nature.

1. In the preparation taken from this case, which is preserved in the Museum of St. George's Hospital, the effect produced by the spirit is such that it is impossible to form an opinion as to the exact character which the disease presented in its recent state. A drawing made by Mr. Perry, whose accuracy as an anatomical draughtsman is well known to the anatomists of this metropolis, supplied this deficiency. It is there seen that the tumour consisted of a congeries of thin membranous cells, in which a solid matter, of no very distinct organisation, was contained.

2. Another preparation, also in the Museum of St. George's Hospital, exhibits a disease, which is evidently of the same nature with that in the case which has been just described. The membranous cells are here seen in the preparation itself; but they are still more distinct in the drawing of the recent parts made by the same artist. The patient who was the subject of this disease was carrying a heavy burden, when his right foot became entangled in a hole in the ground, and he fell. He immediately experienced a severe pain in the knee, and it was after this accident that the enlargement of the joint was first observed. The tumour continued

to increase, with a severe shooting pain, until it was twenty-six inches in circumference. Six years from the time of the first appearance of the disease I amputated the thigh in St. George's Hospital. I have since heard of the patient, who was alive and well, having had no recurrence of the disease several years afterwards.

3. Many years ago Sir Astley Cooper and myself were consulted respecting a lady having a tumour of the knee, the external character of which bore a very close resemblance to what was observed in the two preceding cases. In this instance, also, the patient's attention was first called to the disease after an accident in walking. Besides the large tumour in the situation of the condyles of the femur, there was a manifest enlargement of the whole shaft of that bone, which led Sir Astley Cooper and myself to believe that it partook of the disease of the epiphysis, and that we were therefore not justified in recommending amputation. I have lately had the opportunity of seeing the patient. The tumour of the knee is larger than when I was formerly consulted; but no ulceration of the skin has taken place. There is no enlargement of the inguinal glands; nor are there any other circumstances which justify the conclusion that the disease is of a malignant nature.

If the conclusion at which I have now arrived, as to the nature of the three last-mentioned cases, be correct, I have no sufficient evidence to offer in favour of an operation performed for the removal of a joint affected with malignant disease, in which a portion of the bone, in which the disease has originated, is allowed to remain. Cases may have occurred in which there was no recurrence of the disease under these circumstances; but there has been no such favourable result in any of those in which I have had the opportunity of learning the patient's history afterwards; and, as I have already observed, it is not what our experience of the effects of operations performed for malignant diseases in other organs would lead us to expect. I confess that it seems to me that the rule of practice is sufficiently obvious, though there may be

some difficulty in the application of it to individual cases, on account of our having no certain marks by which we may, at all times, and in every instance, distinguish diseases which are malignant, and diseases which are not malignant, from each other.

Morbid growths, having their origin in the bone or periosteum in the immediate vicinity of a joint, are more or less liable to be confounded with disease beginning in the joint itself; and at all events, as they increase in size, they cannot fail to produce the effect of limiting the motions of the joint, and ultimately destroying its organisation. The following case will serve to illustrate the foregoing observations.

Case LXII.

A lady, in the year 1808, first observed a swelling in the upper part of one knee, which was unattended by pain, and which increased slowly, but uniformly. In the course of three years it had attained so inconvenient a magnitude, that she was induced to consent to the loss of the limb. Mr. Thomas, under whose care the patient was, amputated the joint, and allowed me to examine it afterwards.

The tumour occupied the upper part of the knee, beginning at the edge of the cartilaginous surface, and extending about three or four inches up the lower part of the thigh. It was interposed between the muscles and the bone of the thigh, so that the former were seen expanded over it. It was of a greyish-white colour, composed of fibres or of a gristly semi-transparent substance, with osseous matter intermixed with it, and about two inches in thickness on each side of the femur. At the upper part it was seen distinctly originating in the periosteum; at the lower part the periosteum could not be traced, and the structure of the bone was continuous with that of the tumour. The cartilages and ligaments of the joint were free from disease. On the external surface of the synovial membrane, unconnected with the diseased structure above, there were three or four flattened bodies, each of about the size of a kidney-bean, of a white colour, and of a texture somewhat

softer than that of cartilage. The synovial membrane itself was free from disease.

I met with another case in which the patient appeared to labour under an enormous tumour of the hip. It was ascertained, by dissection, that the hip itself was free from disease, and that the enlargement was formed by an osteo-sarcomatous growth from the periosteum of the upper extremity of the femur. Two other cases have come under my observation apparently similar to that just mentioned, but in which I had not the opportunity of examining the parts by dissection.

CHAPTER X.

NEURALGIA OF THE JOINTS.

The term neuralgia merely expresses the fact that pain is referred to a part which is not the actual seat of the disease. Neuralgia of the joints, therefore, like neuralgia of other organs, may arise under very different circumstances. The cause may be purely local. For example:—A man was admitted into St. George's Hospital under the care of Sir Everard Home, complaining of pain in the knee, and of nothing else. On inquiring into his case, however, it was found that he also laboured under a femoral aneurism. Sir Everard Home applied a ligature round the artery above the tumour, which immediately became diminished in size, the pain in the knee subsiding at the same time. The patient died afterwards of venous inflammation consequent on the operation; and on examining the limb I found that some branches of the anterior crural nerve lay on the surface of the tumour, which terminated in the exact spot to which the pain had been referred, and thus at once explained the origin of the pain, and the subsiding of it on the tumour becoming reduced in size after the ligature of the artery.

But by far the most frequent cause of neuralgia of the joints is an hysterical state of constitution. It may therefore well be supposed that the disease is more common in the female than in the male sex. The latter, however, is not altogether exempt from it. Some years ago a large proportion of the cases which were treated as those of diseased joints were of this description; and, looking back at the early part of my own practice, I am sensible that the mistake is one which I have often made myself. The subject is

now better understood by surgeons; nevertheless the same mistake is occasionally made even at the present time.

Having elsewhere given a detailed account of this order of cases,* it will be sufficient for me in this place to give a general description of them, without entering into the history of the individual cases on which my observations have been founded.

The persons most liable to be thus affected are young women of an hysterical constitution, especially those belonging to the more affluent classes of society, living in hot rooms, taking little exercise in the open air, and of self-indulgent habits. Others, however, are not altogether exempt from the disease, and we meet with it occasionally in those who have been brought up in the most prudent manner, in female servants, and even among the peasantry.

The symptoms may frequently be traced to the circumstance of the patient's attention having been anxiously directed to a particular joint. Sometimes they have followed a blow or wrench, or some very trifling injury. At other times, when one sister has laboured under an actual disease of the spine or hip, in another the same parts have become the seat of hysterical neuralgia. At first there is pain referred to the afflicted joint, of which the patient complains in different degrees, not only in different cases, but even in the same case, at different periods. Often if her thoughts are occupied by some other object of interest, she seems to forget the pain altogether, although there is no doubt that at another time she suffers severely. The pain is variously described, but it has an anomalous character, and the description of it rarely corresponds to that of pain arising from inflammation. The joint is tender, but the tenderness is peculiar also. A light touch, or even pinching the skin, will often cause more pain than a firm and steady pressure, causing the patient to wince, and even exciting motions very similar to those of chorea. The same handling of the joint, which seems to cause great distress when the patient is questioned on the subject, if her attention can be directed to other matters, will be altogether unnoticed. Another very characteristic

* Lectures illustrative of certain Local Nervous Affections.

circumstance is, that whatever the pain may be during the day, it does not awake her from her sleep at night. When the spine is affected the pain is referred not to any one spot, but to various parts—from the lower part of the loins to the upper part of the back. Many cases, to which the undefined appellation of spinal irritation has been of late years applied, are examples of this constitutional affection, and not of any local disease.

Occasionally, when a joint has been for a considerable time the seat of hysterical pain, a slight degree of diffused swelling is perceptible in it, apparently the consequence of some effusion into the cells of the cellular texture external to it. This corresponds to what may be observed in some other cases of neuralgia. In a gentleman who was the subject of facial neuralgia (*tic douloureux*) attended with an unusual degree of suffering, there was the same kind of swelling of the face, although there could be no doubt that the real seat of the disease was not in the nerves, but in the brain itself.

At other times there is a periodical change of temperature, not only of the affected joint, but even of the whole limb. In the morning it is cold and pale, and shrunk. Towards evening there is evidence of a more active circulation. The surface of the skin is sensibly hot, red, and shining. During the night the heat and redness subside, and these alternations are as regular as the paroxysms of an ague. Such cases are not very uncommon, and they are always very perplexing to the practitioner who, for the first time, is consulted about them.

The recovery of patients labouring under these hysterical afflictions is often very tedious. But much depends on the treatment, moral as well as physical.

The sulphate of quinine, preparations of iron, the citrate of quinine and iron, may generally be exhibited with advantage; and these may, according to circumstances, be combined with ammonia or the ammoniated tincture of valerian. In most instances the bowels are in a very torpid state, and active purgatives are from time to time required. The air of the country, and especially that of the

sea-coast, is more favourable to the patient than that of a large town; and while at the sea-side she may use cold sea-bathing with advantage, during the summer and early part of the autumn. However, as to constitutional treatment, the best rule that can be laid down is, that the medical attendant should inquire into the state of the general health, and prescribe for the patient according to the circumstances of each individual case. If the menstruation be irregular, deficient, or excessive, he should make it an especial object to restore this function to a healthy condition.

In those cases in which the limb is alternately cold in the morning, and hot, red, and shining in the evening, quinine may be exhibited, as in other intermitting diseases, with the greatest advantage. In proportion as the circulation is deficient and the limb cold at one period of the day, so is the reaction greater at another. The observation of this circumstance has led me to direct that the limb should be covered by a thick stocking of what is called *fleecy* hosiery in the morning, with a large loose case or boot of oiled silk drawn over it; and that in the evening, when the skin begins to be red and hot, this covering should be removed, and compresses, wet with a spirituous lotion, substituted for it. I have found this treatment to produce a marked mitigation of the symptoms.

To a considerable extent these cases admit of being benefited by medical and surgical treatment; but what I have termed the moral treatment of them is of still greater importance. If a young lady who is thus afflicted be confined to her sofa, her attention being constantly directed to her complaint by the anxious inquiries of her friends, the daily visits of her medical attendant, and the exhibition of a variety of drugs, the symptoms may continue unaltered for many months, and even (and that is by no means an unusual occurrence) for several years. The very opposite course to this should be pursued. Her attention should be as much as possible directed to other objects. She should enter into the society, and join in the pursuits of persons of her own age. She should be encouraged to use the limb, even though the attempt to

do so gives her pain in the first instance; and she should pass a portion of each day in the open air. Under this mode of treatment I have known many cures to be obtained without any medical or surgical treatment whatever.

The time which elapses before the cure is completed differs in different cases, and according to a variety of circumstances. In some instances the cure is, or seems to be, instantaneous. A young lady who laboured under an hysterical affection, simulating disease of the hip-joint, recovered suddenly one night while in the act of turning in bed. In other instances the symptoms have been relieved on the exhibition of some new medicine, or the application of some new plaster or liniment, which therefore has obtained, though it has not deserved, the credit of the cure. Any considerable impression suddenly made on the nervous system may produce the same result. A young lady, who had long laboured under hysterical neuralgia of the hip and thigh, immediately lost all her symptoms on being thrown from a donkey which she was riding. Another case has been published as an example of a cure by divine interposition—the immediate cause of it being the prayers of the patient's spiritual instructor, and his command 'in the name of the Saviour that she should get up and walk.' As might be expected, examples of similar cures have been furnished by mesmerism and homœopathy.

CHAPTER XI.

CHRONIC ABSCESS IN THE ARTICULAR EXTREMITY OF THE TIBIA.

CHRONIC inflammation, producing a chronic enlargement of the epiphysis, is a not unfrequent occurrence, and is liable to be mistaken for disease in the joint itself; the more so, as inflammation of the synovial membrane sometimes occurs as a secondary disease. The patient, under these circumstances, may derive benefit from the use of sarsaparilla, mercury, hydriodate of potash, or mezereon; from the application of blisters, and in some instances from the division of the inflamed and thickened periosteum; in short, from any of those remedies which are found to be useful where nodes are formed in other parts of the bones.

Occasionally chronic inflammation of the articular extremity of the tibia terminates in the formation of an abscess in the centre of the bone, but contiguous to the joint. An abscess of this kind is attended with an extraordinary degree of suffering, such as not only would justify amputation, if there were no other means of obtaining relief, but would induce the patient cheerfully to submit to the operation. Fortunately a less formidable mode of cure is within our reach. My first knowledge of this disease was derived from the following case.

CASE LXIII.

Mr. P., about 24 years of age, consulted me in October 1824, under the following circumstances:—

There was a considerable enlargement of the lower extremity of the right tibia, extending to the distance of two or three inches

from the ankle-joint. The integuments at this part were tense, and they adhered closely to the surface of the bone.

The patient complained of a constant pain, referred to the enlarged bone and neighbouring parts. The pain was always sufficiently distressing; but he was also liable to more severe paroxysms, in which his sufferings were described as most excruciating. These paroxysms recurred at irregular intervals, confining him to his room for many successive days, and being attended with a considerable degree of constitutional disturbance. Mr. P. described the disease as having existed more than twelve years, and as having rendered his life miserable during the whole of that period. In the course of this time he had been under the care of different surgeons, and various modes of treatment had been resorted to without any permanent advantage. The remedies which I prescribed for him were equally inefficacious. Finding himself without any prospect of being relieved by other means, he made up his mind to lose the limb by amputation; and Mr. Travers having seen him with me in consultation, and having concurred in the opinion that this was the best course which could be pursued, the operation was performed accordingly.*

* It is right that I should state briefly the termination of the case, especially as the circumstances attending it were probably connected with a peculiar condition of the nervous system, occasioned by the long continuance of the local disease. Unfortunately I preserved no notes of this part of the case at the time; but I have no doubt that my recollection is accurate as to the following particulars. The patient bore the operation with the utmost fortitude, but immediately afterwards he was observed to become exceedingly irritable, restless, and too much disposed to talk. Unfortunately, in the evening, there was hæmorrhage from the stump, which ceased, however, on the removal of the dressings and coagulum. During the night he had no sleep; and on the following day he was restless and incessantly talking, with a rapid pulse. These symptoms became aggravated. There was no disposition to sleep, and the pulse became so rapid that it could be scarcely counted. Until the third or fourth day the tongue remained clean and moist. After this period it became dry, and somewhat brown, and there was constant delirium. The pupils were widely dilated, and the sensibility of the retina was totally destroyed; the glare of a candle not being perceptible even when held close to the eye. Death took place on the fifth day after the operation. No morbid appearances were observed in the post-mortem examination.

On examining the amputated limb, it was found that a quantity of new bone had been deposited on the surface of the lower extremity of the tibia. This deposition of new bone was manifestly the result of inflammation of the periosteum at some former period. It was not less than one-third of an inch in thickness; and, when the tibia was divided longitudinally with a saw, the line at which the new and old bone were united with each other was distinctly to be seen.

The whole of the lower extremity of the tibia was harder and more compact than under ordinary circumstances, in consequence, as it appeared, of some deposit of bone in the cancellous structure; and in its centre, about one-third of an inch above the ankle, there was a cavity of the size of an ordinary walnut, filled with a dark-coloured pus. The bone immediately surrounding this cavity was distinguished from that in the neighbourhood by being of a whiter colour, and of a still harder texture, and the inner surface of the cavity presented an appearance of great vascularity. The ankle-joint was free from disease.

It seems highly probable that, if the exact nature of the disease had been understood, and the bone had been perforated with a trephine, so as to allow the pus collected in its interior to escape, a cure would have been effected without the loss of the limb, and with little or no danger to the patient's life. Such, at least, was the opinion which the circumstances of the case led me to form at the time; and I bore them in my mind, in the expectation that, at some future period, I might have the opportunity of acting on the knowledge which they afforded me, for the benefit of another patient.

Case LXIV.

Mr. B., at that time 23 years of age, consulted me in the beginning of February 1826. There was considerable enlargement of the right tibia, beginning immediately below the knee, and extending downwards, so as to occupy about one-third of the length of the bone.

Mr. B. complained of excessive pain, which disturbed his rest at night, and some parts of the enlarged bone were tender to the touch. The knee itself was not swollen, and its motions were perfect.

He said that the disease had begun more than ten years ago, with a slight enlargement and pain in the upper extremity of the tibia; and that these symptoms had gradually increased up to the time of my being consulted. Various remedies had been employed, from which, however, he had derived little or no advantage.

Having inquired into the circumstances of the case, I was led to regard it as one of chronic periostitis; and I adopted the following method of treatment.—An incision was made longitudinally on the anterior and inner part of the tibia, extending from the knee four inches downwards, and penetrating through the periosteum into the substance of the bone. The periosteum was found considerably thickened, and the new bone, which had been deposited beneath, was soft and vascular. The immediate effect of the operation was to relieve the pain which the patient suffered, so that he slept well on the next and every succeeding night. After this I prescribed for him a strong decoction of sarsaparilla. The wound gradually healed; and it was for some time supposed that a perfect cure had been accomplished. The enlargement of the upper extremity of the tibia, however, never entirely subsided; and in August 1827, pain was once more experienced in it. At first the pain was trifling, but it gradually increased; and when I was again consulted, in January 1828, Mr. B. was unable to walk about, and quite unfit for his usual occupations. At this period the pain was constant, but more severe at one time than at another, often preventing sleep during several successive nights. The enlargement of the tibia was as great as when I was first consulted; and the skin covering it was tense, and adhering more closely than is natural to the surface of the bone. Some remedies which I prescribed were productive of no benefit. The patient's sufferings were excruciating, and it was necessary, that he should, if possible, obtain immediate relief. The

resemblance between the symptoms of this case and those of the case last described was too obvious to be overlooked. It appeared highly probable that they depended on the same cause; and I therefore proposed that the bone should be perforated with a trephine, in the expectation that an abscess would be discovered in its interior. To this the patient readily assented; and, accordingly, the operation was performed in the beginning of March 1828.

My attention was directed to a spot about two inches below the knee, to which the pain was especially referred. This part of the tibia was exposed by a crucial incision of the integuments. The periosteum now was not in the same state as at the time of the former operation: it was scarcely thicker than natural, and the bone beneath was hard and compact. A trephine of a middle size was applied, and a circle of bone was removed, extending into the cancellous structure, but no abscess was discovered. I then, by means of a chisel, removed several other small portions of bone at the bottom of the cavity made by the trephine. As I was proceeding in this part of the operation, the patient suddenly experienced a sensation, which he afterwards described as being similar to that which is produced by touching the cavity of a carious tooth, but much more severe; and immediately some dark-coloured pus was seen to issue slowly from the part to which the chisel had been last applied. This was absorbed by a sponge, so that the quantity of pus which escaped was not accurately measured; but it appeared to amount in all to about two drachms. From this instant the peculiar pain belonging to the disease entirely ceased, and it has never returned. The patient experienced a good deal of pain—the consequence of the operation—for the first twenty-four hours; after which there was little or no suffering. The wound was dressed lightly to the bottom with lint. Nearly six months elapsed before it was completely cicatrised; but, in about three months from the day of the operation, Mr. B. was enabled to walk about and attend to his usual occupations. He continued well when I last saw him on the 7th of January 1832,

and the tibia was then reduced in size, so as to be scarcely larger than that of the other leg. No exfoliation of bone had ever taken place.

Since the occurrence of this case, five similar cases have come under my care, in every one of which a complete cure was at once obtained by the same operation: so that I have the satisfaction of knowing that in my own practice as many as six individuals have been enabled to preserve limbs which must inevitably have been amputated if the dissection of the limb in one other case had not made me acquainted with the real nature of the disease under which they laboured. In confirmation of this last observation, I need only refer to an interesting statement, published by Mr. Kirby, in the 'Dublin Medical Press,' for December 3, 1845, which will explain the ravages ultimately produced by this disease, if it be not relieved by art.

Having in another publication given the details of all the cases to which I have just referred,* it seems unnecessary for me to do more at present than to offer a few general observations on the subject.

Chronic abscess of the extremity of the tibia may exist during a very long period before it interferes with the neighbouring joint. In one case the patient had laboured under the symptoms of the disease for as many as eighteen years before I was consulted. The symptom by which the disease is indicated in the first instance is pain in the affected part, which is more or less of an intermitting character. The pain gradually becomes more severe, but still it is intermitting. For some time the patient may suffer so little from it, that he is not prevented from attending to his usual occupations; then, without any manifest reason, a paroxysm occurs, in which the pain is intense, he is utterly disabled, and even unable to quit his bed. This gradually subsides, and he has another interval of

* Lectures illustrative of various subjects in Pathology and Surgery.

ease. As the disease goes on, the bone becomes increased in size, the general health becomes affected, and the mind probably is rendered miserable and irritable by long-continued suffering. In one case, whenever the patient began to use the limb the knee itself became inflamed, and there was an effusion of fluid into the cavity of the synovial membrane. The case of Kendrow, already recorded in the sixth chapter, Case LI., explains the probable cause of this complication to have been the attempt of the abscess to make its way into the knee-joint, through the cartilage of the tibia. If, in this case, the application of the trephine had been much longer delayed, we cannot doubt that the joint would have been destroyed, and that there would have been no means of relieving the patient except by amputation.

Now, I do not say that in all cases in which the combination of symptoms exist which I have just described, the surgeon should at once conclude that there is an abscess in the interior of the bone, and that the trephine should be applied for the purpose of making an opening into it. For the most part there can be no danger in deferring the operation until it has been ascertained whether such remedies as mercury, sarsaparilla, or iodide of potassium (which are known to have the power of subduing chronic inflammation of bone), will afford the desired relief. But if these methods fail I cannot doubt that it is the duty of the surgeon to perforate the bone with the trephine. Hitherto, in no instance in which I have performed the operation, have I failed in discovering the abscess. But, even if abscess should not exist, I can conceive that the perforation of the bone, by relieving tension, and giving exit to serum collected in the cancellous structure, might be productive of benefit; and at all events the operation is simple, easily performed, and cannot itself be regarded as in any degree dangerous.

The most important point in the operation is that of ascertaining the exact part at which the trephine should be applied. I have always found that there was one spot to which the pain was more especially referred, and which was more especially sensible

to pressure; and when this has been satisfactorily determined, I have concluded that this was the part at which the perforation should be made. The trephine which I have generally used is a little more than half an inch in diameter, and is made without any projecting rim, so that there is nothing to prevent it penetrating to any depth that may be required. Sometimes when I have taken out a portion of the bone by means of the trephine, I have found it expedient to make use of a common elevator to complete the operation, by breaking down the immediate boundary of the abscess, but I have never yet had occasion to make a second application of the trephine. However, such an occasion may occur. A very experienced hospital surgeon applied the trephine for a supposed abscess in the head of the tibia. No abscess however was discovered, and in consequence the limb was amputated. On the parts being examined afterwards, the abscess was discovered at a small distance from the perforation made in the operation; and it was plain that the removal of a small portion more of the bone would have preserved the patient's limb.*

* The late Mr. Hey, in his Practical Observations on Surgery, has given the history of several cases, in which he applied the trephine to the tibia affected with caries. But these cases were very different from those which form the subject of the present chapter; there having been, not a defined abscess in the centre of the bone, but an external sore, with thickened periosteum, and an aperture in the bone, through which a probe could be passed into the internal cavity.

CHAPTER XII.

ON CARIES OF THE SPINE.

Section I.

Pathological Observations.

Although it is not to be supposed that the synovial membranes belonging to the joints between the articulating processes of the vertebræ are altogether exempt from the liability to inflammation, there is no doubt that inflammation is, in them, a rare occurrence, and no case has fallen under my own observation in which the existence of such disease was proved by the examination of the dead body.

It is obvious that no diseases corresponding to those of the synovial membrane can occur in the joints between the bodies of the vertebræ. But analogy would lead us to expect, and experience demonstrates, that those diseases which occur in the harder textures may occur here as elsewhere, and that an extensive caries of the spine may have its origin, sometimes in ulceration of the intervertebral cartilages, and at other times in a morbid condition of the cancellous structure of the bones.

In one of the cases which have been related in a former chapter, where ulceration of the articular cartilages had begun in several other joints, those between the bodies of some of the dorsal vertebræ were found to have been very much altered from their natural structure. I had an opportunity of noticing a similar morbid condition of two of the intervertebral cartilages in a patient who,

some time after having received a blow on the loins, was affected with such symptoms as induced Mr. Keate to consider his case as one of incipient caries of the spine, and to treat it accordingly with caustic issues; and who, under these circumstances, died of another complaint.

Opportunities of examining the morbid appearances in this very early stage of disease in the spine are of very rare occurrence, but they are sufficiently frequent where the disease has made greater progress; and in such cases I have, in some instances, found the intervertebral cartilages in a state of ulceration, while the bones were either in a perfectly healthy state, or merely affected with chronic inflammation, without having lost their natural texture and hardness; while in others it has been manifest that the original disease has been that peculiar scrofulous condition of the bones, the effects of which in the bones and joints of the extremities have been described at length in a former chapter.

The following cases illustrate the foregoing observations, and (if I am not mistaken) will be found to exhibit the more important changes connected with caries of the spine as far as this can be ascertained by dissection.

Case LXV.

Christiana Clear, a girl 8 years of age, was admitted into the infirmary of the parish of St. George, Hanover Square, in the year 1808, on account of a disease of the spine. At this time, the upper part of the spine was bent forward, and the spinous processes of some of the dorsal vertebræ formed a preternatural projection at the posterior part; but still she was able to walk without assistance.

Soon after her admission an abscess presented itself, and burst in the groin; and this was followed by a second abscess, which burst near the former.

The child was now under the necessity of being confined entirely to her bed. The abscesses continued to discharge pus. She became affected with hectic fever; nevertheless, more than

two years elapsed from the time of her having been first admitted into the infirmary before she died.

The body was examined by Mr. Howship, to whom I am indebted for this account of the case. It was universally anasarcous. The abdominal muscles were so wasted, that scarcely any vestige of them was perceptible. This probably arose from the circumstances of the child having remained in bed for so long a time previous to her death, and having scarcely ever varied her position.

At the posterior part of the abdomen, there was a confused mass of soft substance, which proved to be the parietes of an abscess communicating with the orifices in the groin.

The bodies of the lowest dorsal and three superior lumbar vertebræ were found at the posterior part of the abscess, nearly consumed by caries. There were no remains of the intervertebral cartilages between the tenth and eleventh dorsal, nor of those between the third and fourth lumbar vertebræ. These intervertebral spaces were filled with pus, and the opposite surfaces of the vertebræ were carious, but only to a small extent. The central part of the intervertebral cartilage between the ninth and tenth dorsal vertebræ had been completely absorbed, and pus was found in its place. Externally to this, the concentric layers of elastic cartilage were entire, though somewhat altered from their natural appearance.

Case LXVI.

Mr. M., a young man in the summer of 1816, became affected with pain in his back, and general debility, which he attributed to his having lain on damp ground, while in the Island of Ascension, in the preceding March. In the beginning of September he sailed for England, being compelled to return home, on account of the state of his health.

In February 1817 he arrived in London, complaining of pain in the back, and numbness of the thighs. Soon afterwards, on examining the spine, it was observed that that part of it which is formed by the dorsal vertebræ was incurvated forward, and that

there was an evident lateral incurvation also. After this, an abscess burst in one groin, and continued open, discharging a large quantity of matter. The lower extremities became imperfectly paralysed; he lay constantly on one side, with the thighs drawn forward, so that his knees nearly touched his chin, and never varied from this position. He lingered until the 10th of August 1818, when he died.

On inspecting the body, I found an abscess, which occupied nearly the whole of the anterior surface of the spine, from the upper part of the posterior mediastinum as low as the pelvis, and which communicated with each groin, extending downwards in the direction of the *psoæ* muscles. In many parts, in consequence of the contact of the matter of the abscess, the bodies of the vertebræ, and even the heads of the ribs, were affected with a superficial caries.

There were no remains of the intervertebral cartilage between the fourth and fifth dorsal vertebræ, and the opposite surfaces of these two vertebræ were consumed by caries to some extent, and hence arose the curvature of the spine forward; and they were consumed to a greater extent towards the left side than towards the right, which explained the lateral curvature.

The intervertebral cartilages between the eleventh and twelfth dorsal vertebræ had also entirely disappeared, and the opposite surfaces of these bones were in a state of caries; but this had not extended itself sufficiently to occasion any sensible loss of bony substance.

The intervertebral cartilages between the third and fourth, fifth and sixth, seventh and eighth, tenth and eleventh dorsal vertebræ, and also that between the twelfth dorsal and first lumbar vertebræ, were all in a perfectly natural state towards the circumference; but in the centre they were of a dark colour; and on the surfaces towards the bones they, as well as the bones themselves, were in a state of incipient ulceration, but without any appearance of pus having been secreted.

All the other intervertebral cartilages were throughout their

whole substance in a natural condition; and the bones of the vertebræ everywhere had their natural texture and hardness. On laying open the theca vertebralis, the membranes of the spinal chord were found adhering together, behind the space between the fourth and fifth dorsal vertebræ.

Case LXVII.

Francis May, 13 years of age, was admitted into St. George's Hospital on the 24th of March 1833.

He complained of severe pain in the back of the neck, in which situation there was much thickening, and some enlargement of the soft parts.

There was also an angular curvature in the situation of the seventh, eighth, and ninth dorsal vertebræ; and he complained of pain in this part of the spine. There was no loss of sensibility or power of motion in the limb, his general health was much impaired, and he perspired profusely day and night.

Two years and a half ago, after an attack of rheumatic fever, he complained of severe pain in the back, which continued for a month or six weeks, and then subsided. A year ago the angular projection of the spine was first noticed. Seven months afterwards he first complained of pain in the neck; at the end of another month the pain in the back (which had subsided) returned. This was followed by the bursting of an abscess of the nates, discharging a large quantity of offensive pus.

He was directed to remain altogether in the recumbent posture, and some tonic remedies, with diluted sulphuric acid, were prescribed. A blister was applied to the back of the neck, which in some degree relieved the pain in this part.

May 6th, an abscess presented itself in the posterior part of the pharynx. It was opened on the 9th of May, and a small quantity of pus was evacuated.

Soon after this diarrhœa supervened, and the patient died on the 2nd of June.

On dissection it was found that the cartilaginous surfaces between the atlas and dentata had been destroyed by ulceration. The cartilages of the joints between the occiput and atlas were partly ulcerated. The transverse ligament was destroyed. The odontoid process of the dentata was scabrous, and partially dislocated. The abscess of the pharynx communicated with the carious surfaces. There was a small quantity of fluid effused in the basis of the cranium, but the brain was free from disease.

The bodies of the eighth and ninth dorsal vertebræ were destroyed by ulceration. An abscess communicating with the carious surfaces of the seventh and tenth dorsal vertebræ extended downwards, first in the course of the psoas muscle, then backwards on the inner edge of the quadratus lumborum, and thence to the nates, where it had formerly burst.

The remaining vertebræ were of their natural texture and hardness.

The following case is of much interest, not only as it shows the effects produced by caries of the spine, and the connection between this disease and that of ulceration of the cartilages of the hip; but also as affording an example of the cure of the latter disease, and cicatrisation of the ulcerated surfaces under no other treatment than that of perfect rest in the recumbent posture.

Case LXVIII.

Mary Price, 16 years of age, was admitted into St. George's Hospital on the 24th of December 1828.

She complained of pain in the loins, which was aggravated by pressure made on the situation of the upper lumbar vertebræ, and by sitting erect.

She also complained of pain in the left hip, which was more severe during the night than during the day, and attended with painful startings of the limb. The pain extended from the groin downwards, and was aggravated by exercise and by pressure on the great trochanter.

She was confined to her bed in the horizontal posture; and an issue was made with caustic in the left groin.

Under this treatment, the symptoms were almost entirely relieved. But she now began to complain of a cough, attended with pain in the chest, and difficulty in making a full inspiration. Soon afterwards she expectorated pus; and she died on the 18th of March 1829.

On dissection, tubercles with a considerable abscess were found in the left lung.

There was a small abscess lying behind the left psoas muscle, which communicated with a space between the fourth and fifth lumbar vertebræ, formed by the ulceration of the intervertebral cartilages and the adjoining surfaces of the vertebræ. The bones of the vertebræ retained their natural hardness, but were of a pale colour, apparently in consequence of their possessing a somewhat smaller degree of vascularity than under ordinary circumstances.

In the left hip-joint the synovial membrane appeared to be a little more vascular than usual. In the neighbourhood of the insertion of the round ligament the cartilage of the acetabulum had disappeared, but it had been replaced by a membraneous substance, adhering to what would have been otherwise an exposed surface of the bone. In another spot at the upper part of the acetabulum, the cartilage had also disappeared, and the bone itself had become exposed. The bone, however, was hard and compact, and rather more elevated than the bone in the neighbourhood, so as to justify the notion that it had become cicatrised after having been in a state of caries.

Case LXIX.

Charlotte James, 19 years of age, was admitted into St. George's Hospital on the 30th of May 1821. About a month before her admission she had experienced pain in the loins, which was relieved by cupping. At the time of her admission she had violent pain in the left lower limb, from the hip to the foot; soon afterwards she again complained of pain in the loins; and about the

same period a tumour presented itself in the loins on the right side. Her constitution also became affected with hectic symptoms.

On the 2nd of June the tumour was punctured, and sixteen ounces of pus were evacuated. Another abscess presented itself in the groin.

The hectic symptoms continued; she gradually sank, and died on the 3rd of August.

On dissection the bodies of the three or four inferior lumbar vertebræ were found preternaturally vascular, and of a dark and almost black colour; but they retained their natural texture and hardness, and had undergone none of those changes which mark the existence of the scrofulous affection of the bones. The intervertebral cartilages were in a natural state; but the body of one of the vertebræ was superficially ulcerated for about the extent of a sixpence on one side, towards the posterior part. A large abscess communicated with the ulcerated surface, and occupied the situation of the psoas muscle of the left side, extending downwards to the groin.

Case LXX.

Edward Griffiths, 45 years of age, was admitted into St. George's Hospital on the 5th of April 1818, on account of an abscess, which presented itself in the left groin. He said that, about four months before his admission he had been seized with pain in the loins, and that the tumour in the groin had appeared about six weeks after the commencement of the pain.

He was directed to remain constantly in the horizontal position; and in a short time the tumour formed by the abscess in the groin disappeared, and another showed itself over the left *os innominatum*. On the 15th of May, this abscess was opened, and about forty ounces of pus were discharged. After this, he gradually sank, and died, worn out by a profuse suppuration, on the 19th of August following.

On dissection, it was found that the cancellous structure of all the dorsal and lumbar vertebræ was of a dark red colour, and

softer than natural, so that they might be cut with a common scalpel, or even crushed by the pressure of the thumb and fingers.

The opposite surfaces of the bodies of the second and third lumbar vertebræ, and of the cartilage between them, at the posterior part, were extensively destroyed by ulceration. Anteriorly, the bones and the intervertebral cartilage were entire, and the latter was in a perfectly natural state; but the bones throughout were of a dark and almost black colour.

On one side of the body of the twelfth dorsal vertebra, there was a small ulcerated spot, forming an opening, which extended itself into a small cavity in the centre of the bone. This bone was also of a black colour; but the intervertebral cartilages belonging to it, as well as the intervertebral cartilages connected with the other vertebræ, were in a perfectly natural state.

The abscess had originated in the carious surfaces of the second and third lumbar vertebræ, and had extended itself behind the left psoas muscle, as low as the upper and anterior part of the left thigh; where it made a turn backwards on the inside of the tendon of the psoas muscle, and thus made its way to the place where it was opened on the posterior part.

The ribs were throughout unusually vascular and brittle, so that they might be broken by the slightest force. There were vomicæ in the lungs, and tubercles in the liver.

Case LXXI.

Henry Shaw, 17 years of age, consulted Mr. Earle in November 1816, on account of a complaint which had begun about three months before, and of which the following were the most remarkable symptoms:—

He had frequent attacks of pain in the head, attended with giddiness. Occasionally he had fits, in which he was for a short time insensible, with a spasmodic action of some of the muscles of the neck. The right eye was amaurotic, and there was constant tinnitus aurium. His mental faculties were for the most part unimpaired.

By Mr. Earle's directions, he was cupped; purgatives were administered, and he was kept under the influence of mercury during six weeks, at the end of which time his symptoms had nearly disappeared.

About the end of May 1817, he went on a visit into the country; and while there, he one day tripped and fell in crossing the room. Another set of symptoms now showed themselves, for which he was brought to London. At this time he had pain in the back and in the right side, shooting in the direction of the costal nerves. He was subject to severe cramps in the stomach; his bowels were irregular; and he breathed with difficulty. He had cramps in his lower limbs, and his locomotive powers were impaired, though there was no actual paralysis of the muscles. His general health was much deranged. On examining the spine, Mr. Earle discovered a curvature, of which the convexity was turned backwards, occupying about the three middle dorsal vertebræ; and this was attended with a considerable alteration in the form of the chest. He was now removed into St. Bartholomew's Hospital, where Mr. Earle directed him to remain constantly in the horizontal position, and an issue was made with caustic on each side of the spine. In a short time he lost the cramps of his lower extremities; but his general health continued to fail, and the difficulty of breathing increased.

In the middle of December, he quitted the hospital. The exertion of being moved seemed to aggravate the disease. He was seized with numbness of the left leg and thigh; the dyspnœa became worse; and he sank and died in convulsions, on the 23rd of December 1817.

On dissection, the arachnoid membrane was found opaque and thickened. A large tumour, of almost cartilaginous hardness, was found in the anterior lobe, and a similar one in the posterior lobe, of the right hemisphere of the cerebrum; and a third tumour occupied the greater part of the right lobe of the cerebellum. The ventricles were distended with water.

The right lung was studded with tubercles, and adhered uni-

versally to the pleura costalis. There was a large abscess of the posterior mediastinum; at the bottom of which, the bodies of two of the vertebræ, together with the intervertebral cartilage between them, were found nearly destroyed by ulceration. The other intervertebral cartilages were in a natural state; but the bodies of the vertebræ were soft, and many of them were beginning to ulcerate. The ribs were porous, their cancelli being filled with a curd-like matter; and they were soft, so that they might be divided with a scalpel. Four of the ribs were separated from their attachment to the spine, and were ulcerated as far as their tubercles.

It is unnecessary for me to adduce other cases of caries of the spine in which I had the opportunity of examining the appearances after death, and which did not essentially differ from those already related. The pathological history of the disease may be thus briefly recapitulated.

In some instances it has its origin in that peculiar softened, and otherwise altered condition of the bodies of the vertebræ, the appearance of which, in the bones belonging to other joints, has been described in the last chapter, and which seems to be connected with what is called a scrofulous state of constitution. In these cases ulceration may begin on any part of the surface, or even in the centre of the bone, but in general the first effects of it are perceptible where the intervertebral cartilage is connected with it, and in the intervertebral cartilage itself.

In other cases the vertebræ retain their natural texture and hardness, and the first indication of the disease is ulceration of one or more of the intervertebral cartilages, and of the surfaces of bone with which they are connected.

There is still another order of cases, but these are of more rare occurrence, in which the bodies of the vertebræ are affected with chronic inflammation, of which ulceration of the intervertebral cartilages is the consequence.

In whichever of these ways the disease begins, if not checked in its progress, it proceeds to the destruction of the bodies of the vertebræ and intervertebral cartilages, leaving the posterior parts of the vertebræ unaffected by it; the necessary consequence of which is, an incurvation of the spine forward, and a projection of the spinous processes posteriorly.

At this period of the disease the membranes of the spinal chord sometimes become affected with a chronic inflammation, which may extend even to the spinal chord itself; and where there is much incurvation, the latter not only becomes incurvated with it, but actually compressed in such a manner as cannot fail to interfere with the due performance of its functions.

Suppuration sometimes takes place at a very early period; at other times, not until the disease has made considerable progress. The soft parts in the neighbourhood of the abscess become thickened and consolidated, forming a thick capsule, in which the abscess is sometimes retained for several successive years, but from which it ultimately makes its way to the surface, presenting itself in one or another situation, according to circumstances.

In the advanced stage of the disease, new bone is often deposited in irregular masses on the surface of the bodies of the neighbouring vertebræ, and where recovery takes place, the carious surface of the vertebræ above coming in contact with that of the vertebræ below, they become united with each other, at first, by soft substance, afterwards by bony ankylosis. The disposition to ankylosis is not the same under all circumstances: it is much less where the bones are affected by scrofula than where they retain their natural texture and hardness; and this explains wherefore, in the former class of cases, a cure is affected with more difficulty than in the latter.

Occasionally, portions of the ulcerated or carious bone lose their vitality, and, having become detached, are found lying loose in the cavity of the abscess. It is scarcely necessary to add, that the existence of such exfoliations is of itself almost sufficient to preclude all chance of the patient's recovery.

The foregoing observations are intended to apply to cases of caries of the spine originating in the spine itself: but those who are engaged in investigating the morbid anatomy of these diseases, will find it necessary to distinguish between these and other cases, which may at first appear to be of a similar, but which are in reality of a different nature. The long-continued pressure of an abscess which has originated in the neighbouring soft parts; of an aneurism of the aorta; of a mass of enlarged lymphatic glands, or of any tumour; may produce ulceration of the bodies of the vertebræ: and here we find the intervertebral cartilages in general to be very little, or not at all affected; so that they are left projecting nearly or quite of their natural size, while the bones themselves are in a great degree consumed. In such cases, where the spine is carious in consequence of disease beginning external to it, the symptoms are not the same as where it has begun in the spine itself. For the most part, the affection of the spine is not suspected during the patient's lifetime; and after death it is easy to trace the origin of the disease in the contiguous parts.

Not unfrequently, however, we find caries from disease of the spine itself complicated with caries from external pressure. For example, disease of the vertebral or intervertebral cartilages occasions caries; and this is followed by the formation of abscess. The matter having become accumulated in considerable quantity, the abscess occupies a large space, and, by its pressure on the surfaces of the vertebræ in the neighbourhood, causes an extensive caries of them far beyond the boundaries of the original disease.

No experience which I have had would lead me to believe that the vacant space in the bodies of the vertebræ, produced by the ulcerative process, is ever supplied by a fresh formation of bone. The cure is never accomplished, except by the two vertebræ which form the boundaries of the disease above and below becoming ankylosed, or united with each other. This process, however, is assisted by another, which causes a deposition of new bony

matter, in irregular masses, on the surface of the spine, in such a manner as not only to strengthen the union of the diseased vertebræ, but also to extend the ankylosis to those vertebræ which are in the immediate neighbourhood.

I shall conclude this division of the subject which is before us with the history of a case which illustrates the effect produced by caries of the vertebræ when it affects the uppermost portions of the spinal column.

Case LXXII.

In the summer of 1839 I was consulted with Mr. Nicolson respecting a young lady, seven years of age, who complained of pain and stiffness of her neck. We prescribed for her a course of blue pill with sarsaparilla; and she was supposed to have recovered. She went to Brighton, and returned apparently well in the following October.

She continued well until the 10th of February 1840; when, having gone out in the evening in a carriage to see some illuminations, and being thus exposed to the night air, she complained again of pain in the neck. On the following day she was seen by Dr. Chambers, who prescribed the remedies under which she had recovered formerly; but this time she derived no benefit from them.

In the early part of the ensuing spring, she went on a visit into the country, but returned, in the course of a few days, with an aggravation of all her symptoms.

On the 6th of May, when I was again consulted, she complained of pain in the neck, but more especially on every attempt to move it, walking with great caution, and endeavouring to avoid the slightest jar. The pain in the neck was much increased by pressure made with the hand on the crown of the head. In bed she always lay with her right hand placed under her head to support it, and she breathed with difficulty.

She was directed to take three grains of the *Hydrargyrum cum cretâ* three times daily; but no amendment took place. She lost flesh and strength. On the 23rd of May her right arm became paralysed. On the following day the right leg was affected in the same manner. After another day the left arm and leg were paralysed also. The difficulty of respiration increased; and on the 31st of May she died. The pulse was frequent and small through the whole of the latter period of her complaint.

On dissection the brain was found in a healthy state with the exception of a small quantity of serum in the ventricles. A considerable quantity of lymph had been effused on the upper portion of the spinal chord, underneath the arachnoid membrane, and involving the origin of several nerves. On the outside of the corresponding portion of the dura mater there was a considerable quantity of pus and lymph, occupying the space between that membrane and the vertebræ. The articular cartilage between the occiput and the atlas, as well as those between the oblique processes of the atlas and dentata on the left side, were ulcerated so as to expose carious surfaces of bone. The synovial membranes of these joints were destroyed, and both joints communicated with a small abscess on the external surface of the vertebræ. On the right side the corresponding joints were similarly affected, the disease being, however, in a less advanced state. The transverse ligament of the atlas had disappeared, and the dura mater covering it had been destroyed by ulceration; so that the odontoid process of the dentata was denuded, and projected into the vertebral canal, pressing on the spinal chord. The bodies of the two superior vertebræ were softer than under ordinary circumstances; but the occiput was of its natural texture and hardness. The ligamentum subflavum between the atlas and dentata had disappeared. All the superior vertebræ of the neck were imbedded in lymph, which extended into the neighbouring cellular structure.

Section II.

On the Symptoms of Caries of the Spine.

It has been shown that in all cases the effect produced by caries of the spine is so far the same that it causes a more or less extensive destruction of the bodies of the vertebræ. It is plain, therefore, that up to a certain point, there must be a resemblance in the symptoms by which the disease is indicated.

But it has been also shown that caries of the spine may be the consequence of different morbid conditions of the parts of which the spine is composed; and it is reasonable to suppose that there must be in different cases some difference in the symptoms corresponding to the nature of the original disease.

A still more marked difference in the symptoms is the result of the caries being situated in different parts of the vertebral column, and thus affecting different portions of the spinal chord, and different orders of nerves.

The principal symptoms by which the disease is indicated may be thus briefly enumerated:—

1st. Pain and tenderness in the situation of the carious vertebræ.

2dly. Curvature of the spine forward, with an angular projection of the spinous processes posteriorly, the result of the bodies of the vertebræ having been destroyed, while the other parts of these bones remain entire.

3rdly. Abscess commencing imperceptibly, but at last presenting itself as an external tumour.

4thly. Pains, loss of sensation, coldness, muscular spasms, and paralysis of the extremities.

5thly. Derangement of the functions of the various viscera, which are capable of being influenced by that portion of the spinal chord which is implicated in the disease.

But the whole of these symptoms are not met with in every instance; nor do those which actually exist always show them-

selves in the same order. They are modified and altered according to a variety of circumstances—and to such an extent, that a history of them, which is applicable to one case, may be found to be wholly inapplicable to another. In fact, there is scarcely any disease which presents itself under a greater diversity of forms, or in which, in the early stages at least, so much experience and discrimination are necessary to enable us to form a right diagnosis.

In the majority of cases the first symptom which the patient notices is pain referred to that part of the spine in which the caries exists; at first trifling, but becoming more severe afterwards. The pain is aggravated by any sudden motion of the spine; by percussion, or by a jar communicated to it in any other way; as by stamping on the ground, jumping, striking the foot accidentally against a stone, sneezing, or coughing. In the advanced stage of the disease the pain is sometimes so severe, and so easily induced, that the patient cannot bear the slightest movement. Yet, in other cases, there is sometimes no pain in the spine whatever, from the first access of the disease to its termination. I was consulted concerning a young gentleman, in whom, judging from the degree of distortion, I was satisfied that the bodies of not fewer than four or five of the dorsal vertebræ must have been wholly destroyed, and that the disease had been going on for several years; yet he had never been known to complain of pain; and the first circumstance which attracted the attention of the parents was the angular projection of the spinous processes. This patient ultimately died; and, on examining the body after death, a large abscess was discovered lying on the surface of the carious vertebræ. In another case, in which the disease was supposed to have been cured, and the patient had not experienced pain for the two or three preceding years, on examining the appearances after death, I found the bodies of the vertebræ still in a state of caries, and an abscess, containing not less than half a pint of matter, connected with them.

The distortion of the spine, which occurs in these cases, is of a

peculiar kind. It is bent forward, so as to form an angle projecting posteriorly; and it is evident that this cannot happen without the destruction of the bodies of one or more of the vertebræ.

It is not less evident that the caries must have made considerable progress before this symptom shows itself; and, accordingly, we find that it has been preceded by more or less pain, referred to the affected part, during a period which varies from three months to two years, and which is sometimes even longer than this. I have already mentioned that there are exceptions to this general rule, but these are of rare occurrence; and where pain in the early stage of the disease is wanting, there is usually some derangement of the general health, weakness of the extremities, or other symptoms, showing that the patient labours under some kind of disease, without indicating its exact nature and locality.

In general, the curvature is at first only just perceptible, and, by degrees, it becomes more distinct. In one instance, a young woman, who had made no previous complaints, immediately after some slight exertion, experienced a sensation as if something had given way in her back, and immediately afterwards lost the use of her lower limbs. This was followed by an angular projection of the spinous process of one of the inferior dorsal vertebræ, and a large abscess which presented itself on one side of the abdomen. The patient ultimately died. In another case, after the curvature had taken place, the form of it appeared to vary, in consequence of the diseased vertebræ admitting of being moved to a certain extent on each other; these motions being attended with an increase of pain, both in the spine and in the lower extremities. The last-mentioned patient ultimately recovered.

A distortion of the spine, in the direction forward, may arise from other causes besides caries of the bodies of the vertebræ. On this subject I shall have occasion to offer some observations hereafter. At present it is sufficient for me to observe that in such cases the distortion is never angular, but in the form of a gradual curve, and that it may be thus distinguished from the change of figure which is the result of caries. Nevertheless, I am satisfied

that these two different kinds of distortion have been frequently confounded with each other, and that some of the cases which have been published as examples of caries of the spine, and in which it may, at first, be a matter of surprise that so complete and so speedy a cure should have been effected, have been in reality cases of an entirely different malady.

I have formerly shown that ulceration of the harder textures may make considerable progress in the joints of the extremities without suppuration. It is the same with caries of the spine. I have known as many as three bodies of vertebræ completely destroyed, and the disease to have lasted many years, without matter being formed; a fortunate circumstance for the patient, as the chance of his recovery is much greater under these than it would have been under the opposite circumstances. We must not, however, conclude, because no abscess has shown itself, that therefore no abscess exists. Frequently, in examinations after death, we find an abscess in connection with carious vertebræ, which had never presented itself externally, but which evidently had existed for a considerable length of time.

It is not uncommon to find caries of the vertebræ going on for two or three years before there are any certain indications of the existence of abscess. In one case, in which the disease was in the vertebræ of the loins, an abscess presented itself in the groin at the end of eight years; and in another case, in which the disease was situated in the dorsal vertebræ, the interval was still longer—not less than sixteen years. The formation of abscess is usually attended with some derangement of the general health, such as loss of flesh and muscular power; increased frequency of the pulse; a slight access of fever in the evening, followed by perspirations at night; occasionally, but rarely, rigors.

These symptoms may be in some degree relieved by the first bursting of the abscess; but when the daily discharge of matter has continued for some time, they recur in an aggravated form; the patient wastes under the influence of a hectic fever, and some

kind of visceral disease supervenes, which proves the immediate cause of death.

The foregoing observations relate to cases of caries of the spine generally. We have next to consider the peculiar symptoms which it produces, accordingly as one or another part of the column of the vertebræ is affected by it.

When there is caries of the cervical vertebræ, the patient complains, in the first instance, of pain in the neck, which is aggravated by every motion of the head, and which is not unfrequently mistaken for the muscular pains and stiffness connected with what is commonly called a stiff neck from cold. The pain gradually increases, and, according to my experience, is for the most part more severe than when the seat of the disease is lower down in the spine. The pain is aggravated by pressure on the crown of the head, and by any motion of the head, in consequence of which the patient acquires the habit of supporting the head, especially in walking, or otherwise changing his position, by his two hands, one placed on each side. When, in the progress of the disease, the spine has become bent forward, the angular projection posteriorly is observed to be trifling, except where the lowest or seventh cervical vertebra is implicated in the disease, a difference which is easily explained by the greater length of the spinous process of the latter, as compared with that of the spinous processes of the vertebræ above.

Abscess connected with diseased cervical vertebræ usually presents itself among the muscles on the side of the neck. Occasionally it makes its way forward, forming a tumour, which afterwards bursts into the pharynx. A case has been already mentioned in which matter was found covering the medulla oblongata; and in another case, in which I examined the body after death, the abscess had penetrated into the theca vertebralis, and the whole of the spinal chord, from one extremity to the other, was bathed in pus. At an early period of the disease the patient frequently complains of pains in the arms and shoulders, which, after some time, are followed by paralysis. The general course of the paralytic symp-

toms is, that both upper extremities are affected in the first instance, while the muscles which derive their nervous influence from the spinal chord below the disease remain subject to the will. In a still more advanced stage of the disease the paralysis extends to the muscles of the trunk and lower extremities. Sometimes, however, the course is different; and I have already described a case in which the right upper extremity was first paralysed, then the right lower, then the left upper, and afterwards the left lower extremity. As the disease goes on pains are referred to the abdomen, which becomes distended, and tympanitic, the bowels being at the same time obstinately costive. In all cases there is pain in the occiput and temples, which is, however, more severe when the disease is situated in the two or three superior vertebræ; and it is in these last-mentioned cases more especially that the patient is seen to support his head by his hands, one placed on each side. Not unfrequently the transverse ligament of the second vertebra is destroyed, and the consequence is a dislocation of the odontoid process. Sometimes the dislocation is complete, and the patient, from the pressure made on the spinal chord, expires as suddenly as if the latter had been divided transversely. More frequently it happens that the displacement of the odontoid process is somewhat restrained by the pressure of the dura mater which lies over it. There is then some degree of pressure on the spinal chord, sufficient to excite irritation, but not to destroy its functions. Under these circumstances, the patient complains of increased pain in the head, followed by convulsions, stupor, dilated pupils, and other symptoms of effusion of fluid within the cranium; and on examining the body after death, we find that such effusion has actually taken place, there being a collection of fluid in the ventricles, or in the base of the cranium, or in both of these situations.

In cases of caries of the superior dorsal vertebræ, independently of the usual pain and tenderness of the affected parts, the patient complains of pain and a sense of constriction of the chest; and when the disease is in the inferior dorsal vertebræ there is a similar sensation in the epigastrium, pain in the abdomen generally,

and a disturbed state of the functions of the alimentary canal. Occasionally the urine is alkaline, or it contains albumen, being voided without its natural transparency, and becoming opaque on exposure to heat, or on the addition of nitric acid. From this last circumstance, and from there being at the same time pain either in or near the region of the kidney, it is sometimes difficult, in the first instance, to determine whether the patient labours under caries of the spine or disease of the kidney.

When the spine is incurvated forward, in consequence of the destruction of the bodies of the dorsal vertebræ, the angular projection behind is more distinct than it ever is when the disease has attacked the vertebræ of the neck or loins. This is to be attributed to the greater length of the spinous processes in this part of the spine, and to the circumstance of their being, in the ordinary position of the parts, inclined more or less downwards. When the curvature is considerable the thorax becomes at the same time altered in figure. The diameter of the thorax, from above downwards, is rendered shorter, while the other diameters are increased; so that, while the figure of the chest is altered, there is but little difference in its actual capacity. If, under these circumstances, an opportunity should occur of examining the appearances after death, we find a change in the position of the viscera corresponding to the altered form of the cavity in which they are contained. This is most apparent in the descending aorta, which is seen taking a spiral instead of its usual straight course on the fore part of the spine. When the superior dorsal and inferior cervical vertebræ are both implicated in the disease, a large protuberance presents itself between the superior angles of the scapulæ, and the neck appears shortened, as if it had descended or sunk between the shoulders.

As the disease advances, the patient, in some instances, complains of pains, which are referred to one groin and hip, such as may lead to the suspicion that there is disease in the hip-joint; and, in fact, it is a very common error (and one into which even surgeons of great experience are liable to fall) to regard the symptoms of

caries of the middle and inferior dorsal vertebræ as indicating incipient caries of the hip. Afterwards there are pains, combined with a sense of constriction, in the legs and thighs. The muscles are found to be not properly under the dominion of the will, so that the patient occasionally loses a step, or trips in walking, and this is probably followed by a complete loss of voluntary power. In some cases the paralysis is so complete that the muscles of the lower extremities never act under any circumstances; while in others, although they do not act under the influence of volition, they are subject to spasmodic and in some instances to permanent contractions.

Occasionally the loss of voluntary power over the muscles is attended with a total loss of sensibility; but more frequently while the former function of the nerves is destroyed, the latter remains but little or not at all impaired.

Paralysis of the bladder, and incontinence of the urine and fæces, sometimes exist in combination with paralysis of the lower limbs, forming a most distressing addition to the patient's other calamities.

A considerable time generally elapses before abscess connected with caries of the dorsal vertebræ presents itself externally. Sometimes it shows itself on the posterior, or lateral, or even on the anterior, part of the chest, having penetrated through one of the intercostal spaces. More commonly it makes its way downwards through the posterior mediastinum, behind the small muscle of the diaphragm; and then, taking the course of the psoas muscle, passes behind the crural arch, and appears in the anterior and upper part of the thigh. It is not uncommon for the abscess to form a large tumour on one side of the abdomen, occupying the whole, or a great part, of the space between the false ribs and the groin, pushing the viscera to the opposite side, and, at last, making its way to the surface, either through the abdominal muscles, or under the crural arch. But a very great length of time may elapse before it reaches this termination. I have known such an abscess to remain neither increasing nor diminishing in size, nor being

materially changed in its situation, for several successive years; in some instances forming a soft and compressible tumour, in which the fluctuation of matter was distinctly perceptible; in others, having the character of an irregular mass of solid substance, in which no fluid could be detected by the touch. Inexperienced surgeons not unfrequently mistake an abscess, under these last-mentioned circumstances, for an encysted tumour, or some other morbid growth.

When the lumbar vertebræ are affected with caries, the patient usually complains of pain in the region of the loins; which is aggravated by stooping, turning the body suddenly round, or by percussion. Sometimes the pain is confined to the vertebræ themselves; while at other times it extends forwards, in the direction of the lumbar nerves, to the sides of the abdomen and the crista of the ilium.

When abscess is formed, it usually either descends in the direction of the psoas muscle, and presents itself behind the crural arch in the upper and anterior part of the thigh, or otherwise makes its way backwards on the outer edge of the quadratus lumborum and sacro-lumbalis muscles, showing itself on one side of the loins. In some rare cases, it takes the course of the spermatic chord, and forms a tumour protruding through the abdominal ring, such as a superficial observer might easily mistake for a hernia; or it descends into the pelvis, and afterwards into the posterior part of the thigh, following the direction of the sciatic nerve, through the sacro-sciatic notch of the pelvis. Occasionally it reaches this last-mentioned situation in another way. I have known an abscess to have descended from the loins, and presented itself as a tumour in the groin. Suddenly the tumour has disappeared, and the patient has been led to entertain hopes of a speedy recovery. But these have been soon disappointed, in consequence of the discovery of a large collection of matter in the posterior part of the limb, behind the little trochanter of the femur. In a case of this kind, in which I had the opportunity of examining the morbid appearances after death, I found that the

abscess had taken the course of the common tendon of the psoas magnus and iliacus internus muscles to their insertion into the bone, afterwards extending further backward, below the inferior edge of the quadratus femoris.

I may take this opportunity of observing, that it is by no means uncommon, whatever part of the spine may be the seat of caries, to find an abscess thus altering its course, disappearing in one place, and some time afterwards appearing in another; and this seems to afford a reasonable explanation of some of those cases in which it has been supposed that an abscess has been suddenly removed by absorption.

It very rarely happens that this disease, when confined to the loins, proceeds so far as to occasion any perceptible alteration in the figure of the spine; and this peculiarity is easily explained by the greater magnitude of the bodies of the lumbar, as compared with those of the cervical or dorsal vertebræ, in consequence of which the former are not destroyed by the same extent of caries which would be sufficient for the destruction of the latter.

The same circumstance will also, in great measure, account for another peculiarity of this disease, when it affects the lower portion of the spine, namely, the absence, in the majority of cases, of pains, muscular spasms, paralysis, and loss of sensibility in the lower limbs. In fact, in these cases it seldom happens that the caries extends so far as to reach the theca vertebralis. In one case, in which the patient had complained of numbness of the legs and thighs, I found, on dissection, that the theca vertebralis was in no part exposed; but that there was a large abscess on each side surrounding the lumbar nerves, and thus explaining the diminished sensibility of the parts to which these nerves were distributed.

In systematic works on surgery the lumbar or psoas abscess is usually described as if it were (in some instances at least) a specific or primary disease, having its origin in the psoas muscle. But, according to all the experience which I have had of these cases, this is altogether a mistaken view of the subject. I cannot say that such

an abscess never takes place in the loins; but I certainly believe that it is of very rare occurrence. In examining cases of lumbar abscess after death, I have always found caries of the vertebræ, in which the abscess has manifestly originated. In general the disease of the vertebræ has been so obvious, that it could not have been overlooked by the most superficial observer; but, in some instances, the real nature of the disease has not been detected until after a careful dissection. In one instance, on examining the body of a patient who died in St. George's Hospital with an extensive suppuration in the loins, the soft parts having been entirely removed, not the smallest appearance of disease presented itself in the lumbar vertebræ, and I conceived that I had at last met with a case of genuine psoas abscess; when, almost accidentally, a small opening was discovered on one side of the spine, in a part which had been covered by one of the attachments of the psoas muscle, just large enough to admit a common probe, and forming a communication between the cavity of the abscess, and one of the intervertebral spaces. On a further dissection, it was ascertained that the intervertebral cartilage had been completely destroyed by ulceration, except at its circumference, and that the opposite surfaces of the bodies of the two contiguous vertebræ were extensively carious.

Another question still remains to be considered:—

Are there any circumstances by which in the living person we may distinguish from each other the different forms of caries of the spine, according to the different morbid condition of the bones and intervertebral cartilages in which the disease has its origin?

My experience leads me to believe that we may do so, but only to a limited extent; that in some cases we may make a nearly certain diagnosis, and only a doubtful one in others.

Caries, which has its origin in a scrofulous condition of the bones, for the most part occurs in young persons under, or not much exceeding, the age of puberty, having what is called a

scrofulous aspect, and not unfrequently has been preceded by scrofulous enlargement of the lymphatic glands, or scrofulous disease of one or more of the joints of the extremities. In such cases the pain in the affected portion of the spine is generally trifling, and sometimes none at all, except when specially induced by jumping or some other sudden concussion. I have known very many cases in which a young patient has never complained of pain, nor has the existence of disease of any kind been suspected, until the mother or the nurse has discovered an angular projection of the spinous processes, indicating that the caries had already made a very considerable progress. In a case to which I have already alluded, which I had the opportunity of watching for some years, and in which the spine was distorted to a very unusual extent, with a large abscess in the abdomen; the patient suffered so little pain or other inconvenience, that several practitioners who were at different times consulted, were led to the conclusion that no caries existed, and that the alteration in the figure of the spine depended on some other cause. One surgeon had actually recommended a course of gymnastic exercises for the purpose of rectifying the deformity. At last the death of the patient, and the examination of the body afterwards, proved the correctness of my diagnosis.

In a case of scrofulous caries of the spine, I doubt whether the patient ever escapes the formation of abscess. At any rate, such an event is of very rare occurrence. I know that patients sometimes appear to recover without abscess having shown itself, in whom an abscess exists nevertheless, in what may be called an inactive state, and I have already referred to cases which confirm this observation. If under these circumstances the opportunity presents itself of examining the parts by dissection, the parietes of the abscess are found consisting of a dense solid mass adhering to the spine above and below the parts destroyed by the caries, while the contents of it are converted into a thick cheesy matter in consequence of the absorption of the thinner part of the purulent secretion.

In those cases which are not of scrofulous origin—that is, not preceded by the scrofulous change in the organisation of the bones—the patients are generally advanced beyond the age of puberty. Many of them have been previously subject to some form of rheumatism, and from this and other circumstances I am led to believe that the caries may frequently be referred to chronic rheumatic inflammation affecting the bones and intervertebral cartilages. Occasionally nodes on some of the cylindrical bones have preceded the vertebral disease. In such cases the pain in the spine is often very severe, and the patient's sufferings are greater than in those of the truly scrofulous disease; but I am inclined to believe that there is a much greater probability of the patient recovering without the formation of abscess—a circumstance of great importance, as it justifies, for the most part, a more favourable prognosis.

In all cases of caries of the spine there is some difficulty in making a positive diagnosis in the early stage of the disease, previously to the appearance of angular curvature. The disease being for the most part confined to the bodies of the vertebræ, and these being at a considerable distance from the surface of the body, there is generally no external tenderness. Innumerable mistakes have been made, and many individuals have been condemned unnecessarily to a long-continued surgical treatment, in consequence of the surgeon examining the spine with a view to discover the last-mentioned symptom. There is scarcely any delicate young woman, especially among those belonging to the (so-called) better class of society, who will not complain of some parts of the spine being tender if it be firmly pressed; and in any thin person, of either sex, pain will be produced by pressing the skin against the projection of the spinous processes. Instead of trusting to such a mode of examination, it is best to place the patient standing on a chair or table, and desire him to jump off of it on the ground; and I believe that where caries exists, it may generally be detected by the effect produced by this kind of concussion.

Section III.

Treatment of Caries of the Spine.

The rule which was laid down as to the treatment of diseased joints of the extremities are not less applicable to all cases of caries of the spine. As far as that can be accomplished, the diseased parts should be kept in a state of absolute and complete repose. While the patient is in the erect posture, and the weight of the head and other superincumbent parts is pressing on the ulcerated surfaces, and while these are liable, in the various motions of the body, to a constant (however trifling) friction, it is not probable that the progress of ulceration can be checked, or that suppuration can be prevented. From the first moment therefore in which the nature of the case is clearly indicated, the patient should abandon his usual habits, and be confined altogether on his bed or couch. In some instances, in which severe pain in the vertebræ is among the early symptoms of the disease, he will submit to the privations which are thus imposed upon him with sufficient willingness; while in others, nothing but a candid exposition of the ill consequences which may otherwise arise, will overcome his reluctance to do so. The invalid bedstead, contrived by Mr. Earle, and which I have formerly mentioned, will, in ordinary cases, afford the most convenient means of conducting this part of the treatment. The manufacturer of the bedstead has lately added to it what, with such experience of it as I have hitherto had, I am led to regard as a very great improvement. Instead of a board, or canvas, that portion of the mattress which corresponds to the head or trunk of the patient is supported by vulcanised Indiarubber, perforated with holes so as to prevent the accumulation of damp from perspiration. This has most of the advantages which belong to the water-bed, and is without some inconveniences to which the latter is liable, where the patient can never be moved from it.

By the use of the invalid bedstead the patient is enabled to

obtain some change of position; as the trunk and thighs may be, from time to time, and within moderate limits, raised or lowered, so that their relative position may be varied without the smallest movement being communicated to the carious vertebræ. He may also be wheeled from one room into another, or into the open air, in fine weather. As a general rule it is better that he should be in the supine posture, lying on his back; but he may occasionally relieve himself by lying on his side. On no account should any attempt be made, either by laying the patient on his back, on a flat board, or by the application of machinery, to remove the angular curvature, so as to restore the spine to its original shape. Without such undue interference on the part of the surgeon, the carious surface of the vertebra above will always come in contact with that of the vertebra below; and it is to the union which takes place under these circumstances, at first by soft substance, and afterwards by bony matter, and to this alone, that we are to look for the patient's recovery. Whatever disturbs this process (and any attempt to straighten the spine cannot fail to do so) must therefore be carefully avoided.

The recumbent position does not constitute the only means which we have in our power to employ for the purpose of maintaining the diseased spine in a state of perfect repose. When the disease is situated in the dorsal or lumbar vertebræ, the patient may be provided with a bandage, including some stripes of whalebone, and somewhat resembling the stays worn by females, but extending as low as the symphysis of the pubes, the os sacrum, and the great trochanter, and as high as the neck. This will operate like splints, keeping the pelvis and thorax in the same relative position. A less efficient support may be given to the cervical vertebræ by means of an air-cushion, or a bag of Indiarubber partially distended with water, placed so that the occiput and neck may rest upon it.

Under certain circumstances, the prone couch contrived by the late Mr. Verrall may be useful, by affording the patient the relief arising from a change of posture. But it should be used only

occasionally, as, in young persons especially, the constantly lying on it for any considerable length of time is liable to produce a very perceptible flattening of the anterior part of the chest.

In the early part of my professional life, I was led to follow the practice which was then very generally adopted of treating caries of the spine by means of setons and caustic issues, one on each side of the diseased vertebræ. A more enlarged experience has satisfied me that, in the very great majority of cases, this painful and loathsome mode of treatment is not only not useful, but actually injurious. The observations which I made on this subject formerly, with reference to scrofulous diseases of other joints, are equally applicable to cases of scrofulous diseases of the spine. For many years past I have ceased to torment my patients who were thus afflicted in this manner, and I am convinced that the change of treatment has been attended with the happiest result. There are a few cases only in which I am still inclined to believe that issues or setons may be employed with advantage. The cases to which I allude occur almost exclusively in adult persons, where there is severe pain in the seat of the disease, and where from this and other circumstances we are justified in the conclusion that the caries depends, not on a scrofulous condition of the bones, but on disease of the intervertebral cartilages, or a chronic inflammation, probably of rheumatic origin, of the vertebræ themselves. Even in these last-mentioned cases issues and setons do not seem to form any necessary part of the treatment; and I am not myself in the habit of resorting to them unless I find that the pain is not relieved by the recumbent posture, and the other remedies of which I shall speak presently. It appears to me also, that in cases of caries of the spine, as well as in those of caries of other joints, issues and setons are to be employed only in the early stage of the disease, and that no advantage is to be expected from them after abscess is formed.

An important question here presents itself,—For how long a period is the patient to be confined to the recumbent posture? If there be a reason for it being had recourse to at all, there is

also a sufficient reason for it not being abandoned for many months. In the great majority of cases it should be extended to a year, or a year and a half; and where the disease has made extensive progress, even to two or three years.

In the first instance, the surgeon usually finds it difficult to persuade the patient to continue this part of the treatment for a sufficient length of time after the removal of the more urgent symptoms. Afterwards, however, he often has to encounter a difficulty of an opposite kind. This happens especially among young females, who become at last so habituated to their couch and the peculiar mode of life connected with it, that they can scarcely be persuaded to make the necessary effort to sit up and move about, even after every reason for not doing so has vanished.

I have on a former occasion referred to the case of a lady who, under these circumstances, preserved the recumbent position for such a length of time, that all the joints of the lower extremities, in which no actual disease ever existed, from mere want of use, became completely ankylosed. Various attempts were at last made to restore their mobility, but to no purpose, and she still remains in the same condition as when I was first consulted, twenty years ago—unable to use her lower limbs, or even to sit up.

Although the maintenance of the recumbent posture may be regarded as absolutely necessary, it is not on this alone that the surgeon should depend for the patient's cure. Attention must be paid to his general health; and, accordingly as the disease presents one or other character, or as the constitution varies, different modes of constitutional treatment will be required.

Where there is an evident scrofulous diathesis (and in children generally), preparations of iron may be exhibited; and these may be made to alternate with the cod-liver oil, or sarsaparilla, or some of the ordinary tonics. The diet should be simple and nutritious; the bowels should be carefully regulated, and it will generally be necessary, from time to time, to stimulate the action of the liver by small doses of the *hydrargyrum cum cretâ*, or even of calomel. It is scarcely necessary to add that in the majority

of such cases a residence on the sea-coast will be highly beneficial.

In other cases, where it is plain that the disease is not of scrofulous origin, and where there seems to have been no particular vice of the constitution previous to the occurrence of the local disease, mercury may often be administered with the best result; and it is especially useful when the patient suffers a more than usual degree of pain. It may be given in the form of the bichloride or calomel combined with opium, or the common mercurial pill, so as slightly to affect the gums, for three or four weeks, and sometimes for a still longer period; and this may be followed by a course of well-prepared decoction of the best Jamaica sarsaparilla, in as large doses as can be conveniently taken. In other cases in which there seems to be sufficient reason for avoiding the use of mercury, sarsaparilla may be prescribed in the first instance, the course of it being continued two or three months, and repeated some time afterwards.*

With respect to the treatment of abscesses connected with caries of the spine, I am not aware of any circumstances in which it should differ from that of abscesses connected with other joints affected by the same disease. The patient should not venture to take exercise, nor even to quit the recumbent posture until the abscesses are healed. This is to be regarded as the general rule; from which, however, on a very few occasions, it may be right to deviate. I was consulted by a gentleman who was at that time 35 years of age, and who had laboured under well-marked symptoms of caries of the spine since he was 3 years old. There was considerable curvature in the direction forward, with an angular projection of the spinous processes of the middle dorsal vertebræ

* No one who has seen the above-mentioned remedy properly administered can doubt the great efficacy of it in certain cases of disease of the bones and periosteum, as well as in many cases of cachexia, especially that arising from the joint operation of syphilis and mercury. The doubtful reputation which it has obtained with some practitioners is, I apprehend, to be attributed to its being so frequently employed in other cases in which it has no specific influence, to the inferior quality of the drug, or to its being given in insufficient doses.

posteriorly; and there were two sinuses, discharging pus, communicating with the carious vertebræ which had existed for nearly thirty years. Nevertheless the patient had been able to take violent exercise in hunting and shooting, and other ways, and his general health had been excellent. In fact, he had suffered no material inconvenience from his complaint, except that he once lost the use of his lower limbs; recovering it, however, completely at the expiration of three months, and after the application of blisters to the back.

No one who has been much conversant with cases of caries of the spine, can fail to regard it as a most serious disease, of which, even in the more favourable cases, it is impossible to form more than a doubtful opinion as to the result. Nevertheless in those cases in which the patient is so situated that he can have the advantages of wholesome diet, fresh air, and the necessary surgical attention during the long period which is necessary for a cure, a cure will often be accomplished. Many children recover even after the formation of extensive abscesses. The worst cases are those of adults, in which the disease is of scrofulous origin, and complicated with abscess. But even such cases, if the general health can be maintained for a certain length of time, are by no means to be regarded as hopeless. In the year 1829 I was consulted concerning a young gentleman who laboured under a scrofulous disease of the knee. The structure of the joint was wholly destroyed, and I concurred with his other surgical attendants, in recommending the amputation of the limb, which operation was accordingly performed by an eminent provincial surgeon. Some years afterwards, the patient, now a young man, called on me at my own house, to consult me as to an enormous swelling of one leg and thigh. On making my inquiries, I found that he wore a broad belt, fastened tight by buckles round the waist. He told me that he wore it because without it there was a great swelling in one loin. The swelling proved to be an enormous abscess connected with disease of the lumbar vertebræ, such as might be well

supposed to contain two pints or more of pus. The pressure of the belt on this abscess, by preventing it from protruding externally, caused it to impede the return of the blood by the iliac vein, and thus occasioned the swelling of the lower extremity. On removing the belt the tumour in the groin immediately increased in size, and the leg and thigh were reduced nearly to their natural dimensions. By my advice the patient retired to a healthy spot on the sea-coast in South Wales, where he resided in a cottage fronting the sea. Here he lay on a couch exposed as much as possible to the sea-air, the abscess being opened some time afterwards by a surgeon in the neighbourhood. At the end of a year the abscess was healed, and he ultimately recovered. I have since seen him at various times in perfect health, and I have no reason to believe that he is otherwise than well at the present time. I mention the case, because the circumstance of the disease in the vertebræ having supervened on a disease of the knee so extensive as to require amputation, had led me in the first instance to regard it as almost hopeless.

Paralysis of the muscles below the seat of the disease must always be regarded as an unfavourable symptom. Yet, in many instances, after being for some time in the recumbent posture, the power of the will over the muscles begins to be restored; and I have known children, in whom the muscles of the lower limbs had been completely useless, after the lapse of three or four years, to be able to walk, and run, and jump, as well as if they had never laboured under any kind of disease. In one case, indeed, where a little girl had in other respects perfectly recovered from the effects of caries of the upper dorsal (and probably of the lower cervical) vertebræ, she was nevertheless unable to support the weight of the head without the aid of a machine. When this was taken off, the patient being in the erect position, the head fell forwards, so that the chin rested on the sternum. I suspect, however, that in this case the inability to keep the head erect depended on the altered position of the centre of gravity consequent on the spinal curvature, and not on actual paralysis.

Section IV.

On some Cases which are liable to be mistaken for those of Caries of the Spine.

However difficult it may sometimes be to recognise the existence of caries of the spine in the earliest stage of the disease, there is no difficulty in doing so when the disease has gone so far as to produce any considerable destruction of the bodies of the vertebræ. The spine is then bent forwards, the spinous processes in the situation of the disease making an angle projecting posteriorly, and varying, as I have already explained, according to the extent of the caries, and the length and position of the spinous processes. Such an angular curvature can be produced in no other way, and can never be mistaken.

The common lateral curvature of the spine, from whatever cause it arises, is so different from the alteration of figure produced by caries, that it would be but a waste of time to explain the circumstances by which it may be distinguished. But there are other cases in which the spine is incurvated forwards, which have been not unfrequently mistaken for cases of caries, and in which, therefore, it seems important, with a view to a better diagnosis of the last-mentioned disease, that I should offer some observations.

In the cases to which I allude, the spine is bent forwards, not, however, presenting an angle posteriorly, but in such a manner as to form a gradual curvature or arch, including several, and sometimes nearly the whole of the column of the vertebræ. The late Mr. Earle first called the attention of the profession to this subject in a paper in the 11th volume of the 'Edinburgh Medical and Surgical Journal,' and pointed out the importance of distinguishing this, which he called the hoop-like curvature of the spine, from the angular curvature produced by caries.

The hoop-like curvature may arise under various circumstances. Mr. Earle has described cases in which 'the whole vertebral column was slightly arched in the form of a half-hoop,'—this being the result of the muscles not having sufficient power to

preserve the spine erect. In these cases the muscles of the limbs generally were weak; and in one case Mr. Earle, having had the opportunity of examining the body after death, ascertained that there was no disease whatever in the vertebræ, while there was considerable disease in the membranes of the spinal chord. I have notes of a case in some degree analogous, by which I was myself misled in the early part of my practice. The patient was a little girl, who had been for some time weak and drooping, with an indisposition to use her lower limbs, and a gradual curvature affecting the lumbar and inferior dorsal vertebræ. With such knowledge as I then had on the subject, I was led to recommend the recumbent posture, and to establish an issue with caustic on each side of the back. About three weeks afterwards, well-marked symptoms of cerebral disease showed themselves, which in the course of a few days terminated in the patient's death. On the body being examined, I found no unusual quantity of fluid in the ventricles, but a very turgid state of the vessels of the brain, and no caries of the vertebræ.

A similar curvature of the spine occurs in some cases of rachitis, and here it may be distinguished by the alteration of shape in the other bones with which it is accompanied, especially in those of the lower limbs and the chest.

The long continuance of a stooping posture will produce the same effect. My friend the late Dr. Potts gave me the opportunity of examining a dry preparation of a spine in his possession, in which the hoop-like curvature exists in a very remarkable degree. It was taken, as Dr. Potts informed me, from an insane patient who died in the Hôpital Bicêtre at Paris, and who had remained constantly in one position, bent forwards and almost immovable, during a very long period of time. In this instance the bones are deficient in earthy matter, but not more so than is accounted for by the circumstance of the patient having been in a state of total inaction probably for many years.

Some persons, either from their original conformation, or from an early habit of stooping, present the appearance of a very

considerable gradual or hoop-like curvature affecting the lower cervical and upper dorsal vertebræ; and this peculiarity of shape generally increases as they advance in life. In such persons the projection made by the long spinous process of the seventh cervical vertebra may, by a superficial observer, be mistaken for the angular curvature of caries. Such a mistake is most liable to occur in cases of women in whom the neck is exposed, and I have known it to be actually made in more than one instance; thus causing the patient to experience much unnecessary trouble and anxiety.*

Every one who is conversant with pathological museums must have seen specimens in which the bodies of a greater or smaller number of vertebræ are firmly ankylosed, there being at the same time a deposit of bony matter here and there on the surface adhering to the bone beneath, and extending from one vertebra to the other. It is reasonable to suppose that such a change in the condition of the spine must have been the result of a long-continued chronic inflammation; but in no instance in which I have had the opportunity of observing these morbid appearances, have I been able to ascertain what were the symptoms by which the existence of the disease had been marked in the living person.

Some cases, however, have come under my care, in which such were the symptoms under which the patient laboured that they

* It is not my object here to treat of the loop-like curvature of the spine, except so far as it may be considered in its relation to the angular curvature from caries. The inquiry, however, is one of much interest, and well deserves to be prosecuted farther. Although, under ordinary circumstances, this kind of curvature is certainly not productive of any serious inconvenience, I have some reason to believe that when it exists in a great degree, it may ultimately so interfere with the functions of the spinal chord as to become a very serious and even dangerous disease. The evidence which has led me to this remark is not sufficiently complete for me to be justified in laying it before the profession. It may become so hereafter: and in the meanwhile I avail myself of this opportunity of calling the attention of other practitioners to the subject.

seemed to admit of no other explanation than that of attributing them to the above-mentioned disease. The progress of the disease was tedious, extending, when I had the opportunity of watching it, over a period of several years, and it terminated in leaving the spine of its natural figure, but completely rigid and inflexible through the greater part of its extent.

The following history will sufficiently explain the circumstances by which this disease is to be distinguished from caries of the spine, and the treatment which I have been led to adopt with a view to its relief.

Case LXXIII.

August, 1841. A gentleman, 31 years of age, consulted me under the following circumstances:—

He complained of pain referred to the spine from the neck downwards, but especially to the middle dorsal vertebræ. When he attempted to stoop, he experienced a sense of stiffness of the spine, and there was scarcely any perceptible flexure of it, the stooping being apparently confined to the motion of the pelvis on the thigh. A sudden motion had often occasioned an aggravation of the pain in the spine, and on all occasions pain was induced by the act of sneezing, which therefore he carefully avoided. He also experienced at times pains in the pelvis and lower extremities. There was no pain in the head or upper extremities. He was prevented taking exercise in consequence of the pain which it induced; but I could not find that there was anything like paralysis of the limbs, and there was no difficulty of micturition. There was some effusion of fluid in the right knee, as in cases of inflammation of the synovial membrane. He had lost flesh considerably; but his pulse was natural, his bowels were regular, and there were no signs of other disease. He suffered during the night from spasmodic twitches of the lower limbs disturbing his rest.

He had come to England, on account of his complaint, from the Mediterranean, where he had been resident for some years.

He said that the symptoms had begun three years ago, almost imperceptibly. The first of these which attracted his notice was a pain in the back, induced by sneezing. From that time they gradually increased, varying, however, in degree at different periods. He had had some attacks of intermittent fever, each of which was followed by an aggravation of his other complaint.

I prescribed a pill of two grains of calomel with one-third of a grain of opium, to be taken three times daily; and rest in the recumbent posture.

On the 1st of September, the mercury had not affected the gums, but his symptoms were much relieved. He seemed to have gained flesh, and had a more healthy aspect, and the pains and spasms had ceased. The mercury was now omitted, and a course of a strong decoction of sarsaparilla was prescribed in its place.

After an interval of a month, being threatened by a recurrence of some of his former symptoms, he was advised to omit the use of the sarsaparilla, and to resume the use of some mercurial remedies, but in smaller doses than before. The mercurial treatment was continued (some other remedies being from time to time combined with it, to meet occasional symptoms) until the 7th of December. At that time he had none of his former symptoms, except some occasional spasms in the muscles of his lower limbs, and these to a much less extent than formerly. I advised him to take moderate doses of the iodide of potassium, but it disagreed with him, and was therefore discontinued.

He was now compelled by circumstances to return to Malta; and I therefore lost sight of him until the following August (1842), when he was again in England. He was now much improved in all respects; but as he complained of some degree of pain in the back, I prescribed another alterative course of mercury. Under this a further improvement took place, the spine, however, continuing in the same rigid and inflexible state as formerly. In the course of the autumn he was compelled again to return to Malta. From thence I received the following account of him, dated January 28, 1843:—'I am happy to say that the long journey

(overland through France) caused no fatigue. He has been much benefited by the fine weather which we have had. To-day he has walked two miles without resting, and without the least fatigue.'

August, 1844, he was again in England, suffering little or no inconvenience, except from the rigidity of the spine, which remained as it was formerly.

From this time I have had the opportunity of seeing my patient from time to time. He has occasionally suffered from inflammation of the eye, and some other complaints, but has had no return of his former symptoms. The state of the spine is unaltered.

Malignant diseases are occasionally met with in the spine. As might be expected, from the contiguity of the spinal chord and spinal nerves, the symptoms which arise in these cases are very different from those which mark the existence of similar diseases in the joints of the extremities, at the same time that they bear a certain degree of resemblance to those which occur in the advanced stage of caries of the vertebræ. For these reasons I have thought it better to reserve whatever I have to say on the subject to the present chapter.

The spine may be affected by carcinoma, or by the medullary or fungous disease, the former being more frequent than the latter.

The medullary disease may occur as a primary affection. But in all the cases in which I have known the spine to be affected by carcinoma, it has been preceded by the same disease in some other organ. It has generally followed carcinoma of the female breast. In one instance, however, the original disease was a scirrhous tumour of the nostril; and in another, which I have recorded elsewhere,* it was a scirrhous enlargement of the prostate gland. The symptoms of the disease, in the first instance, are always equivocal; and in many instances there must be always more or less doubt as to its exact nature, until the opportunity occurs of ascertaining it by the examination of the morbid

* Lectures on Diseases of the Urinary Organs.

appearances after death. The difficulty of diagnosis, however, is of little importance, as such cases are unfortunately wholly beyond the reach of art. The two following histories will supersede the necessity of a more laboured description.

Case LXXIV.

A lady, 32 years of age, consulted me in the spring of 1832, on account of a scirrhous disease of one breast. There was not a defined scirrhous tumour imbedded in the substance of the breast, but a conversion of the gland itself into the scirrhous structure. The skin covering the breast was thickened, and manifestly contaminated by the disease.

From this time I saw her occasionally, the disease in the breast making little or no apparent progress.

During the night of the 10th of February 1833, she suddenly became paralytic in the whole of the lower part of her person. She not only lost the power of using her lower limbs, but also that of voiding her urine, so that it became necessary to empty the bladder by means of a catheter.

The loss of muscular power was attended with a loss of sensibility as high as the navel and lower dorsal vertebræ. When the catheter was used, she was not sensible of its introduction.

In the beginning of March the lower limbs became affected with involuntary convulsive movements, which were unattended with pain, but of which the patient complained that it was disagreeable to her to see them.

When the paralysis first took place, the urine was clear, and otherwise in a natural state. Afterwards it became ammoniacal and offensive to the smell, depositing a thick mucus, with traces of phosphate of lime in it.

On the 9th of April 1833, the patient died.

The body was examined by Mr. Cutler, and presented the following appearances.

The entire gland of the breast had assumed the scirrhous structure.

Several of the dorsal vertebræ were converted into a substance possessing considerable vascularity, and of a gristly consistence, some of them containing no earthy matter whatever, so that they could be cut with a knife. Altogether the alteration in the condition of the vertebræ seemed to be very similar to that which had taken place in the head of the femur, in a case of which an account is given in a former part of this volume, except that, being more complete, it might be supposed to indicate a more advanced stage of the disease.

The whole of the lower portion of the spinal canal was filled with a serous fluid.

There was a deposit of earthy matter in the upper part of each lung, and about four ounces of serous fluid were contained in the cavity of the right pleura.

The kidneys were of a dark colour, and highly vascular.

The mucous membrane of the bladder bore marks of considerable inflammation. That of the ureters, pelvis, and infundibula of the kidneys, was also inflamed, and in several places lined with coagulated lymph. These last-mentioned parts were considerably dilated, and contained a putrid mixture of pus and urine.

Case LXXV.

A gentleman, 39 years of age, consulted Mr. Tatum on the 15th of July 1849, complaining of a severe pain referred to the right loin, and extending from thence down the outside and fore part of the thigh. The pain was aggravated by certain movements of the body, but there was no tenderness of the parts to which the pain was referred. The patient said that for some years past he had been subject to attacks of what he regarded as lumbago, and that the present attack of pain in the loins had begun a month ago.

Under the use of some remedies prescribed by Mr. Tatum, it was supposed that there was some degree of amendment in the first instance. On the 24th of July, however, the patient was suddenly seized with pain in the loins, more severe than he had

ever before experienced. On every attempt to move, the pain was intolerable, and it was with difficulty that he was placed in an easy chair. On the following day the pain was somewhat less, and he was moved to his bed. Simultaneously with this increase of pain in the loins, he complained of a sense of weight in the region of the cæcum and ascending colon. Some active purgatives were administered, and followed by an enema with oil of turpentine. This produced the discharge of an immense mass of indurated fæces. Other discharges of the same kind took place afterwards, but without being followed by any relief as to the principal symptoms. On the 10th of August there was a difficulty in moving the left leg; and in the course of two or three days more both of the lower extremities were completely paralysed. He was now directed to take calomel combined with opium, with a view to bring the system under the influence of mercury. This was accomplished, but the pain remained unabated, and there was no improvement as to the paralysis. On the 8th of September, for the first time, a fulness was observed in the left loin, the most prominent point being opposite the lowest dorsal and first lumbar vertebræ.

From this time there was no material change in the local symptoms, except the addition of some spasmodic twitches of the muscles of the legs. But the powers of the patient were gradually giving way. He lost flesh, had no appetite for food, was affected with perspirations at night, and the pulse became more and more frequent. On the 16th of December he died.

The body was examined by Mr. Tatum.

A tumour, of the size of a man's fist, was found attached to the bodies of the three superior lumbar vertebræ on the left side, from whence it projected backwards, producing the enlargement which had been perceptible during life in the left loin. The tumour was lobulated, of a brown colour, and presented, when cut into, the usual appearance of medullary or fungous disease.

The body of the second lumbar vertebra had entirely disappeared, but the intervertebral cartilages remained entire, the

space between them being occupied by a process of the morbid growth. The bodies of the second and third lumbar vertebræ were partially absorbed on the left side. Those of the two or three inferior dorsal vertebræ and the superior lumbar vertebræ were soft, so that they could be cut by the knife; and portions of medullary disease, similar in structure to the principal tumour, were found here and there deposited in the cancellous structure. The principal tumour had extended posteriorly and laterally, but externally to the dura mater, so as to compress the cauda equina, and completely to obliterate the second pair of the lumbar nerves. The lower extremity of the spinal chord seemed to be softer than natural, but was not otherwise diseased. There was no appearance of disease in any other part of the body.

The following case is one of much interest in itself; and may not improperly be introduced in this place, as it is one of those which might by a careless observer be readily mistaken for a case of caries of the spine. It confirms a remark which I formerly made as to the operation of disease affecting the cervical portion of the spinal chord in producing paralysis of the upper extremities in the first instance, and of the lower extremities afterwards.

Case LXXVI.

A young man, about 20 years of age, in January 1829, after leading a very irregular life, and after having been much exposed to wet and cold in hunting, was suddenly seized with a violent pain in the neck, followed by considerable swelling. The swelling was situated chiefly on the right side, extending from the head to the shoulder. The patient at first paid very little attention to his complaint, living in the same careless way as before with regard to both diet and exercise; but in spite of this neglect, in a short time, the pain and swelling in a great degree, but not wholly, subsided.

In the beginning of the following April, the upper extremity of

the right side became affected with paralysis. Afterwards the left upper extremity, to a great extent, became paralytic also. In this state he remained, no active remedies having been adopted for his relief until he came under my care in the beginning of June.

At this time he complained of some degree of pain in the back of the head and neck; and he found it difficult to move the head from one side to the other. An enlargement and induration of the soft parts of the neck were still perceptible in the situation of the original swelling. There was complete paralysis of the muscles of the right arm, forearm, and hand; those of the opposite limb were also paralytic, but some of them were still capable of acting feebly, so that he could take hold of the right hand with the left, and move it from one position to another. The muscles of the lower limbs were feeble, but were capable nevertheless of supporting the body in the erect posture.

The bowels were very torpid, and the evacuation of a dark colour, a good deal resembling tar in appearance.

The urine was slightly alkaline, but voided without difficulty.

Leeches were applied to the neck, and afterwards a seton was introduced. Mercury was given so as slightly to affect the gums. No amendment, however, followed the use of these remedies. The lower limbs became paralytic; and on the 19th of June the patient died, having been for a short time previously in a state of coma.

On examining the body after death, the ventricles of the brain were found to contain about two ounces of watery fluid. The brain itself was of an unusually soft consistence.

The cervical portion of the spinal chord was also softer than natural.

A quantity of soft solid substance, of a grey colour, apparently lymph, which had become organised, was found situated between the dura mater and the bodies of the vertebræ, occupying the whole of the anterior and a portion of the posterior part of the vertebral canal, and extending, from the occiput downwards, as low as the fourth cervical vertebra.

A substance similar to that which was found on the inside of the

vertebral canal was also found lying on the fore part of the bodies of the cervical vertebræ, extending over the oblique and transverse processes, and communicating with the internal mass by processes extending through the spaces in which the nerves are situated, and surrounding the nerves themselves. The external mass was much larger than the internal, being not only thicker, but extending lower down in the neck. In some parts it was not less than an inch in thickness; in other parts it was thinner, and, altogether, it was of a very irregular shape.

There can be little doubt that in this case, the original disease was inflammation of the cellular texture in connection with the cervical vertebræ and theca vertebralis; and from its having immediately followed exposure to wet and cold, we may also regard it as having been of rheumatic origin. In the following case, the patient seems to have laboured under a similar disease, having, however, a chronic form, and a more favourable termination.

Case LXXVII.

May, 1838, a gentleman, 40 years of age, consulted me under the following circumstances:—

He had severe pain in the back of the neck and head, and in the side of the neck also, as low as the shoulders. The neck was stiff, and the whole of the soft parts were rigid, the head admitting of scarcely the smallest motion. There were also pains and numbness of the upper extremities as low as the hands, but no loss of the power of motion. In other respects his health was not materially affected. His pulse was natural, and his appetite good, but his bowels were confined. He brought me the following statement from Mr. Sedgwick, of Boroughbridge, by whom he had been recommended to my care:—

'Mr. —— has been subject for many years to attacks of dyspepsia, of rheumatism, and nervous pains. The pain and rigidity of the neck began three years ago, having been preceded by rheumatism of the intercostal muscles, apparently induced by

sleeping in a damp bed. He has also had severe falls from his horse in hunting.'

I prescribed for him a draught containing three grains of the iodide of potassium to be taken three times daily; and two grains of calomel with extract of hemlock to be taken every night at bed-time.

Under this plan of treatment a manifest improvement took place; and when he left my care, at the expiration of three weeks, he was free from pain, and had regained considerable power of moving the head. Mr. Sedgwick has lately been so kind as to furnish me with the following further information respecting him: 'Mr. —— is quite well, with the exception of a slight rigidity of the neck, probably occasioned by a deposit of lymph. He continued gradually to improve under the plan which you recommended, which was continued for some time, and I do not remember that he had another bad symptom.'

I have met with several cases in young persons of an acute inflammatory disease affecting the neck, and bearing considerable resemblance to those described above.

In one case the first symptom was a violent attack of pain, induced while the patient (a little boy) was making a sudden exertion in playing with his brothers. In others the disease supervened on scarlet fever, measles, or simple continued fever. In all of them, after the inflammation had subsided, the neck was left rigid and immovable, and inclined to one side; so that, in some instances, the cheek has almost rested on the shoulder. This may be attributed partly to the inflammation having been greater on one side than on the other, partly to the position which the patient has assumed, lying on one side in bed. The distortion has been sometimes so great as to give rise to a suspicion that some of the vertebræ were actually dislocated. If the disease be treated by leeches, purgatives, and the exhibition of mercury in the first instance, the inflammation is speedily subdued, and the neck restored to its natural figure. Otherwise, after the inflammation has subsided, a course of vapour baths and shampooing, combined with the wear-

ing an apparatus for the purpose of supporting and gradually elevating the head, will be required for the relief of the distortion. If the employment of these remedies be long delayed, more or less of distortion will remain through life.

When the distortion is permanent, a lateral curvature of the whole spine is the necessary consequence. Nor is this all. A remarkable change is ultimately produced in the form of face, so that the forehead, eye, cheek, and jaw on one side are on a different level from the corresponding parts of the opposite side.

Neuralgic affections of the spine have been, and indeed still are, frequently mistaken for caries. The diagnosis of such cases is of the greatest practical importance. I do not, however, feel it necessary in this place to do more than advert to what I have already said on the subject of neuralgia of the joints in a former chapter.

CHAPTER XIII.

ON SOME DISEASES OF THE JOINTS NOT INCLUDED UNDER THE FOREGOING HEADS.

1. It may be laid down as a general rule, that when any organ is attended by inflammation, the disease is in the first instance limited to one of the textures of which that organ is composed, from which, however, it may extend gradually to the adjoining textures afterwards.

But this rule is not without its exceptions. As in a case of severe ophthalmia, the inflammation may at once affect the whole globe of the eye; so that it cannot be said that it begins in any one part more than in another; so it may be supposed that inflammation, when the cause of it (whatever that may be) exists in an intense degree, may affect simultaneously not only all textures belonging to a joint, but even those in the neighbourhood. I have every reason to believe that such cases have occurred under my observation in the living person; but it is only in one instance that I have had the opportunity of determining the correctness of this opinion by dissection.

Case LXXVIII.

A gentleman, about 25 years of age, had laboured for several years under a disease of the brain, in consequence of which he had been in a state of complete helplessness and imbecility. In the summer of 1820 he became indisposed otherwise; there was a cluster of enlarged glands in the left groin, and a purulent sediment was deposited by the urine. I was now desired to see him in consultation with the late Dr. Maton, who was his ordinary medical attendant. Soon afterwards it was observed that there was a

general tumefaction of the left thigh and nates; and the patient complained of pain on certain motions of the limb. Under the treatment employed the tumefaction subsided; but immediately afterwards a violent attack of diarrhœa took place, under which he sank, and died on the 29th of July.

On examining the body, we discovered an abscess, which seemed to have its origin in the cellular membrane of the pelvis, near the neck of the bladder which had burst into the neighbouring portion of the urethra, and which had also extended forwards on the left side, so that it could be traced as high as the mass of enlarged glands in the groin.

The whole of the muscles surrounding the left hip-joint were preternaturally soft and vascular, and so altered from their natural condition that they could be lacerated by the slightest force. They also were to a considerable extent detached or separated from each other, apparently in consequence of a serous fluid which had been effused between them, but of which nearly the whole had become absorbed. The capsular ligament and synovial membrane of the joint were of a red colour and unusually vascular; and the cartilages covering the head of the femur and lining the acetabulum were also red, and of a soft consistence, giving to the fingers a sensation somewhat similar to that which is produced by touching velvet.

The treatment of such cases is sufficiently obvious. The pain induced by any attempt at locomotion will do all that is required to keep the limb in a state of rest; and the surgeon will have to exercise his judgment in the employment of what are called antiphlogistic remedies,—blood-letting, purgatives, mercurial and diaphoretic medicines, and afterwards blisters.

2. In persons advanced in life absorption of the articular cartilages not unfrequently takes place by a peculiar process, different from any of those which have been formerly. It is

sometimes preceded by a fibrous degeneration of the cartilage, while at other times there seems to be simply a wasting of the cartilage, as if it were from defective nutrition, the portion which remains retaining its natural structure and its natural adhesion to the bone. There are no signs of inflammation either during life, nor perceptible on dissection afterwards. The patient never complains of pain, nor does suppuration follow. These changes are often discovered after death, when their existence had never been suspected previously. At other times they produce, in the motions of the limb, a grating sensation, corresponding to but less distinct than the grating which is perceptible after a fracture.

3. The absorption of the cartilage, which has been just described, is not however the only cause of grating or crackling produced by the motion of the joints. This symptom is sometimes manifestly connected with inflammation of the synovial membrane; at other times it occurs, as far as we can see, independently of any other disease, and it is then difficult to offer a reasonable explanation of it. The following case will serve to illustrate this last observation.

Case LXXIX.

A married lady, apparently not more than 26 or 27 years of age, in October 1834, having been then a good deal weakened in consequence of her having suckled her infant for eleven months, observed a grating or crackling to be produced by certain motions of the left knee. This was not preceded by either pain or swelling, and neither pain nor swelling followed. Blisters were applied by the surgeon who attended her, but with no other result than a sensation of weakness in the limb, so that the patient could scarcely walk. After three or four months she had so far recovered from the debilitating effects of the blisters as to be able to walk; but the crackling of the joint was undiminished.

When I saw her in August 1835, she was still free from pain; the knee had its natural size and shape, and the only remaining symptom was, that when the leg was extended on the thigh a

grating and crackling could be felt and heard distinctly. This was especially observed on walking up stairs.

Such cases are not very uncommon, and they occur especially among young women who have a disposition to hysteria. As far as I know they never have any unfavourable termination.

There are some very rare cases in which a peculiar crackling sound is produced during the action of the muscles. The sound is sometimes distinctly to be heard even at a considerable distance. It is difficult to offer any satisfactory explanation of this singular symptom. But the subject does not belong to our present inquiry, and I notice it merely that these cases may be distinguished from those of the crackling of the joints to which I have just referred.

4. We have abundant opportunities of observing that the joints of different individuals are endowed with different degrees of mobility. This is often very evident in the articulations of the fingers with the metacarpal bones. We see one person whose fingers admit of being extended so as to be in a line with the bones by which they are supported, but of no further motion in this direction; and we see another in whom they are capable of being bent backwards so that the nails may be brought almost in contact with the back of the hand. I suppose that this difference is to be attributed chiefly to the state of the ligaments by which the bones are united; and a corresponding looseness of the ligaments, but existing to a still greater extent, will explain the singular liability to dislocation which exists in some individuals.

Case LXXX.

A gentleman consulted me in the year 1820 who had met with the accident of dislocation of the patella four times in the right and once in the left knee. The right shoulder had been twice completely dislocated; and there had been also a subluxation of that joint. The joint of the left thumb, with the os trapezium,

had been dislocated several times. In every instance the dislocation had been reduced with the greatest facility, and generally without surgical assistance. The patient, at the time of my seeing him, was not more than 23 or 24 years of age, and was in perfect health, except that he was subject to occasional severe headaches apparently connected with the state of his digestive organs. No peculiarity could be observed in the form or structure of his joints. His muscles were strong, and he was capable of much bodily exertion. He was accustomed to a good deal of walking exercise, but had not been particularly exposed to the ordinary mechanical causes of dislocation.

A similar looseness of the joints exists in some females disposed to hysteria, and is probably connected with the general weak state of the tissues which makes them also liable to hæmorrhage from the lungs and mucous membranes without any organic disease.

Case LXXXI.

January, 1843, I was consulted by an unmarried lady, 26 years of age, under the following circumstances :—

When she lay flat on a sofa she could by a certain muscular effort, produce a partial dislocation of the hip-joint, apparently bringing the head of the femur out of its natural position, so that it rested on the margin of the acetabulum.

When the muscular effort ceased, the bone returned to its proper situation.

She laboured under other symptoms, such as usually are referred to hysteria; and on inquiry I found that she had suffered from hysteria in various forms for many years. At one time she was the subject of chorea, and then for a considerable time she had been affected with neuralgia of the back, and had been treated by a notorious charlatan as suffering from caries of the spine.

5. I may take this opportunity of noticing a circumstance, which is of some importance as connected with the diagnosis of disease of the hip-joint.

It occasionally happens that the two lower extremities are not of precisely the same length; and this may be the result of original formation, the femur and tibia of one side being respectively longer than those of the other side. If the whole of this difference amounts, as it sometimes does, to an inch, or an inch and a half, the individual is observed to limp in walking, and the great trochanter belonging to one limb is higher and more prominent than that of the other; and this sometimes leads a superficial observer to mistake the case for one of diseased hip. In such cases the necessary consequence is a lateral curvature of the spine, to a greater or less extent in proportion to the difference in the length of the two limbs; and in many instances, and more especially in girls, it is this alteration in the figure which first attracts the notice of the patient's friends.

In some instances a difference in the length of the two lower limbs is the result of disease. A limb which is affected with the paralysis to which children are liable, for the most part does not keep pace in its growth with the sound limb. In some other cases the reverse of this happens, and the diseased limb actually becomes the longer of the two.

Case LXXXII.

Master M. was brought to me from St. Petersburgh for my opinion in June 1832. I saw him in consultation with the late Dr. Lefevre, physician to the British Embassy in that metropolis.

The cicatrices of three or four abscesses were seen in the skin on the anterior and upper part of the thigh, and there was considerable thickening of the deep-seated soft parts in the same situation, there being also a manifest adhesion of them to the bone. The appearance of the limb was such as would lead to the belief that there was a portion of diseased or dead bone of the femur with probably some new bone formed round it; and that this had produced a succession of abscesses of the soft parts as in ordinary cases of necrosis. The history of the case seemed to justify this opinion as to the nature of the disease.

Three years and a half ago the little boy had been suddenly seized with severe pain which was referred to the knee, but only for a few hours, at the end of which time it shifted its place to the upper and anterior part of the thigh. The pain continued, and swelling immediately took place. At the end of six months an abscess was opened, which, however, soon healed. Afterwards a second abscess formed, which was followed by others; but all of them had healed without any exfoliation having hitherto taken place.

There was some degree of stiffness of the hip-joint, but no more than might be reasonably attributed to the thickening and swelling of the soft parts in the neighbourhood. But the most remarkable circumstance in the case was, that the diseased thigh-bone, when measured from the anterior superior spinous process of the ilium to the patella, was found to be at least an inch and a quarter longer than that of the sound limb. The measurement was made repeatedly and with the greatest care, so that there could be no mistake respecting it. There was no perceptible difference in the length of the bones of the two legs.

In consequence of one limb being thus longer than the other, when the patient stood erect, with the soles of his feet planted on the ground, the great trochanter on the side of the disease appeared to project unnaturally, and this occasioned a manifest alteration in the form of the nates, somewhat corresponding to what is observed in the less advanced stage of disease of the hip-joint. That this appearance of the nates was to be attributed solely to the difference in the length of the two limbs, was proved by this circumstance, that it was at once removed by placing a book an inch and a quarter in thickness under the foot of the sound limb, so as to raise that side of the pelvis to the same level with the other.

Case LXXXIII.

August 30, 1839, I was consulted concerning a young man, 17 or 18 years of age, under the following circumstances:—

There was a sinus having an external opening on the outside of

one thigh, a little above the middle, apparently extending towards the base of the great trochanter. The thigh-bone of the same side, when carefully measured from the anterior superior spinous process of the ilium to the patella, was found to be three-fourths of an inch longer than that of the opposite side. There were no signs of other disease. The hip-joint was movable in every direction, and free from pain.

Some years ago the patient had had an attack of inflammation of the femur, which seemed to have terminated in necrosis. No exfoliation had ever taken place, but an abscess had formed, and there had been occasional attacks of inflammation, pain, and swelling, whenever the matter did not readily escape.

It is well known that in advanced life it not unfrequently happens that the neck of the femur becomes shortened by means of a process which has been described under the name of interstitial absorption. Where this change occurs it is certainly, under ordinary circumstances, not confined to one femur; so that, although the limbs are shortened, there is still no difference in them as to length. Mr. Gulliver has, however, published some cases which have led him to the conclusion that such a shortening of the neck of the femur sometimes exists on one side and not on the other. It appears to me that the subject requires further investigation. But Mr. Gulliver's observations are of much interest, and at present I have only to refer to his papers on the subject in the forty-sixth volume of the Edinburgh Medical and Surgical Journal.

6. The circumstances of the following case seem to be best explained by supposing that there was disease of the sacro-iliac articulation corresponding to what I have regarded as rheumatic caries of the spine. Such disease is either of very rare occurrence, or has been much overlooked by others as well as myself.

Case LXXXIV.

June 15th, 1848, a married lady, about 40 years of age, consulted me under the following circumstances:—

She was unable to walk without the aid of crutches.

She complained of pain after taking exercise, referred to the right sacro-iliac articulation and the right groin, but did not experience any severe pain otherwise.

The hip-joint admitted of complete motion in every direction without pain, and presented no signs of disease.

When the patient was placed in the supine posture, with the two limbs parallel to each other, the space between the anterior superior spinous process of the ilium and the patella on the right side we found to be two inches less than that on the left side. On further examination, with a view to determine the immediate cause of the shortening of the limb, I discovered a remarkable projection in the situation of the right sacro-iliac articulation, as if the ilium had been displaced and drawn upwards, of course drawing the hip-joint upwards with it. I could discover no other explanation of the apparent alteration in the length of the limb, nor had any other presented itself to the surgeons who had seen the patient previously,—Mr. Poyser of Wirksworth, who was her general medical attendant, and Mr. Hodgson of Birmingham, whose opinion had been asked in consultation.

The former of these gentlemen gave me the following account of the previous history of the case.

'Fourteen years ago Mrs. —— began to suffer from what was regarded as sciatica, which for several years recurred in the winter, and subsided during the warm weather of summer. Four years ago, during her first pregnancy, she suffered pain which was referred to the hip, and for three months before her confinement she was quite unable to walk. In about three months after her confinement she was again able to walk, but with difficulty and pain. She was again confined in February 1846, and since then has never been able to walk without crutches. In the inter-

val between her two confinements, she underwent a course of what is called the hydropathic treatment. After the birth of her second child she was advised to ride on a donkey, which however brought on so much pain that she was compelled to be laid up altogether, and have recourse to leeches. Afterwards an issue was made with caustic, and kept open for a considerable time, with some apparent relief.'

I proposed for the patient a course of the bichloride of mercury with sarsaparilla, and that she should persevere in the system which had previously been begun under the direction of her former surgical attendants, of remaining in the recumbent posture on the sofa; and I am happy in being able to state, on the authority of Mr. Poyser, that she is now so far recovered as to be equal to the ordinary duties of life, though still labouring under the inconvenience of a shortened limb and a distorted pelvis. The medicines which I recommended were, I believe, taken only for a limited period of time, and there is no doubt that her cure is mainly to be attributed to the long continuance of the state of perfect rest, —a circumstance which strongly confirms the opinion that the disease was analogous to that of caries of the spine, though affecting a different articulation.

CHAPTER XIV.

ON INFLAMMATION OF THE SYNOVIAL BURSÆ.*

Section I.

History and Symptoms of this Disease.

Inflammation of the synovial bursæ is marked by nearly the same characters, and (allowance being made for the difference of the parts with which they are connected) produces nearly the same results as inflammation of the synovial membranes of the joints. In the greater number of instances it occasions an increased secretion of synovia. In other cases the bursæ are distended by a somewhat turbid serum, with portions of coagulated lymph floating in it. Occasionally the disease terminates in the formation of abscess. Sometimes the membrane of the inflamed bursa becomes thickened, and converted into a gristly substance. I have seen it at least half an inch in thickness, with a small cellular cavity in the centre containing synovia. At other times, although the inflammation has continued for a very long period, the membrane of the bursa retains nearly its original structure.

Inflammation of a synovial bursa may be the consequence of pressure, or of other local injury. It may arise from the too great use of mercury, from rheumatism, or from some other constitutional affection; and in such cases, it is frequently combined with

* I include under this head the membranes forming the sheath of tendons, which have the same structure, answer a similar purpose, and cannot with propriety be distinguished from other bursæ. I have adopted the term *synovial bursæ* instead of that which was in use formerly, as it expresses more accurately the structure and functions of the organ to which it is applied.

inflammation of the synovial membranes of the joints. Sometimes it has the form of an acute, but more frequently it has that of a chronic inflammation.

The inflamed bursa forms a tumour, more or less distinct, according to its situation; more or less painful, according to the character of the inflammation. If the bursa be superficial, the fluctuation of fluid within it is, in the first instance, very perceptible; and under these circumstances, if the inflammation be considerable, it extends to the surrounding parts, and occasions a redness of the skin. When the disease has existed for some time, it generally happens that the fluid is less distinctly to be felt, on account of the membrane having become thickened; and where this alteration takes place to a great extent, the tumour exhibits all the characters of a hard solid substance, of which the fluid contents are imperceptible.

When the inflammation is of long standing, it is not unusual to find, floating in the fluid of the bursa, a number of loose bodies of a flattened oval form, of a light brown colour, with smooth surfaces, resembling small melon seeds in appearance. There seems to be no doubt that these loose bodies have their origin in the coagulated lymph which was effused in the early stage of the disease; and I have had opportunities, by the examination of several cases, to trace the steps of their gradual formation. At first the coagulated lymph forms irregular masses of no determined shape, which afterwards, by the motion and pressure of the contiguous parts, are broken down into smaller portions. These, by degrees, become of a regular form, and assume a firmer consistence, and at last are converted into the flat oval bodies, which have just been described.

When inflammation of a synovial bursa ends in suppuration, the abscess sometimes makes its way directly to the surface of the skin, and bursts externally; but I suspect that, in other cases, the matter, in the first instance, escapes into the surrounding cellular membrane, and then it is liable to be confounded with those abscesses which originate in this texture. The following

circumstances seem to warrant this opinion. There is no bursa more liable to be inflamed than that between the patella and the skin; and inflammation of it not unfrequently terminates in suppuration, as I have ascertained to be the case, both by the discharge of pus, when the tumour has been punctured, and by dissection after death. It is very common to find a large abscess on the anterior part of the knee, which the patient describes as having begun over the centre of the patella in the situation of this bursa. The abscess has a somewhat peculiar character. It raises the skin from the patella, so that the latter cannot be felt; and from this point, as from a centre, it extends itself between the skin and the fascia, equally in every direction, covering the whole of the anterior part of the knee. A careless observer (judging from the general form of the tumour, and the fluctuation of fluid, without noticing the greater redness of the skin, and the circumstance of the fluid being over, instead of under, the patella) might mistake the case for one of inflammation of the synovial membrane of the joint itself. Such an abscess must be supposed to commence either in the bursa above mentioned, or in the cellular texture. The original situation of the disease corresponds to that of the bursa; there appears to be no reason why an abscess of the cellular texture should occur in this precise spot more frequently than elsewhere; and hence it is reasonable to conclude, that the bursa is the part in which the abscess begins. It is not improbable that some other abscesses of the extremities may have a similar origin. The tumour which occurs in the inside of the ball of the great toe, and which is one of those to which the name of bunion has been applied, occasionally suppurates; and I have found, on dissection, that this is formed by an inflammation of the bursa, which is here situated.

It frequently happens, after the inflammation has entirely subsided, that the disposition to secrete a preternatural quantity of fluid still remains, and that a dropsy of the bursa is the consequence; in like manner as hydrocele takes place in some cases, as a consequence of inflammation of the tunica vaginalis of the testicle.

In such cases the disease assumes various forms, according to the situation of the affected bursa, and its connection with the parts in the neighbourhood. To describe the whole of these would be an almost endless, and indeed an unnecessary, undertaking; and a few examples will sufficiently illustrate those points with which it is most important that the surgeon should be acquainted.

Enlargement of a superficial bursa is always easily recognised. The tumour formed by the bursa, between the patella and the skin, when distended with lymph or serum, can be mistaken for no other disease. At first the parietes of it are thin, and the fluctuation of fluid is distinctly perceptible in it. But when the disease is of long duration, the thickening of the membrane of the bursa gives the disease all the character of a solid tumour. In one case having attained the size of a small orange, the bursa was removed by an operation. The parietes of it were found to be half an inch in thickness, and of a fibrous structure, while the interior retained its cellular character and contained a serous fluid.

A tumour formed by a distended bursa is of very frequent occurrence in the popliteal space. It is probably that belonging to the tendon of the semi-membranosus muscle. When the leg is extended, the tumour is tense and prominent; but when the leg is bent it recedes so as to be scarcely perceptible. In many instances it exists in combination with inflammation of the synovial membrane of the knee; and as the cavity of the bursa in some instances communicates with that of the joint, the extension of disease from one part to the other is easily explained.

When the disease affects the synovial membrane belonging to the tendons of the flexor muscles of the fingers, it forms a tumour in the palm of the hand, and another in the anterior part of the carpal extremity of the fore-arm, separated from each other by the angular ligament of the wrist; communicating, however, beneath it, so that the pressure which diminishes the size of one tumour increases that of the other.

The most perplexing cases to the surgeon are those in which there is disease of the deep-seated bursæ in the neighbourhood of

the hip and shoulder. An obscure pain in the vicinity of the joint and (in the shoulder especially) a crackling sensation, perceptible to the hand, produced by the motions of the limb, combined with a difficulty in explaining the symptoms otherwise, may justify the suspicion that these bursæ are inflamed and swollen; but the large mass of muscles by which both these joints are protected, renders it impossible to form any certain diagnosis, except in a few cases in which the bursal tumour is of sufficient size to present itself externally. A large swelling, formed by a cyst containing serum only, or serum with flakes of lymph floating in it, is occasionally met with protruding from under the inferior edge of the trapezius muscle; which may be traced to the immediate vicinity of the shoulder-joint, and which seems to have its origin in one of the bursæ belonging to the muscles inserted into the large tuberosity at the end of the humerus. I have known a similar tumour to protrude from under the edge of the glutæus maximus muscle, containing between one and two pints of serum, and which seemed to have a similar origin near the joint of the hip. Bursal tumours of the hip are also found making their appearance on the outside, or on the forepart, of the joint, having made their way outwards through the interstices of the muscles. So, in other situations, similar tumours often show themselves at a distance from the part in which the disease began.

Bursal tumours rarely cause any serious inconvenience, except from their bulk and from their mechanically interfering with the functions of the parts in which they are situated. Occasionally, however, they suppurate, producing abscesses which are difficult to heal, in consequence of the purulent contents not readily escaping, and burrowing among the neighbouring textures. Here, as in other cases, the cyst in some instances becomes gradually converted into a thick fibrous mass, so as to form a solid body with a small central cavity. In the case of the large cyst, which has been mentioned as protruding from under the edge of the glutæus maximus, I had the opportunity of watching its progress during several successive years. At first the membrane of the

cyst was thin, so that the fluctuation of the fluid which it contained was as distinct as possible; but, gradually masses of solid matter were deposited in it, which gave it, in certain parts, an almost cartilaginous consistence.

Section II.

Treatment of this Disease.

The treatment of inflammation of the synovial bursæ is to be conducted on the same principle as that of inflammation of the synovial membranes of joints. For the most part the inflammation may thus be easily relieved; and if the proper remedies be had recourse to in the early stage of the disease, the fluid which has been effused becomes absorbed.

I have stated that when the disease has been long established, the preternatural secretion of fluid will often continue after the inflammation has entirely subsided. Under these circumstances, a blister may be applied and kept open with the savine cerate, the part being at the same time supported by a splint or bandages, so as to limit its motion, or rather so as to keep it in a state of absolute immobility. This treatment will often be attended with a very good result; but the cure is always tedious, occupying a period of many months.

Where the loose bodies, which have been described in the last section, are found in the cavity of the bursa, these may in themselves be sufficient to keep up the formation of fluid. Under these circumstances, the first step towards a cure is to puncture the bursa, so as to allow these loose bodies to escape.

But this operation, simple as it appears to be, is always (except where the bursa is unconnected with tendons, and at the same time superficially situated, as in the instance of the bursa over the patella), to be performed with the greatest caution. The suppuration of a bursa, under any other circumstances, may be productive

of very serious inconvenience, if not of actual mischief, and should not be artificially induced. The tumour may at all times be punctured with a needle, so as to ascertain the nature of the fluid which it contains, and this is sometimes necessary with a view to a more accurate diagnosis. If it be thought expedient to make a larger opening, all undue pressure and rude manipulation should be carefully avoided, and means should be employed for keeping the parts in a state of complete repose afterwards. If these precautions be neglected, active inflammation may ensue, terminating in extensive suppuration, and producing great constitutional disturbance. I know more than one instance in which the death of the patient was the ultimate result of such an operation incautiously performed.

The only exceptions to the rule which has just been laid down, are where the bursa is superficially situated, and unconnected with tendons or the neighbouring joint. In the case of the bursa in front of the patella, I have not unfrequently succeeded in making a cure by laying it open, and dressing the cavity with lint, or by passing a few threads through it in the manner of a seton. A good deal of inflammation has often followed even this operation, but it has never been productive of any further ill consequences. Of course such a mode of treatment ought not to be adopted without confining the patient to a bed or sofa, and preventing the motion of the limb by means of a splint.

When the coats of the bursa have become very much thickened and altered in structure, I am not aware that there is any method by which they can be restored to their natural condition. But if the diseased bursa be situated superficially, it may be removed with as much facility as an encysted tumour. I have never, indeed, performed this operation myself, nor have I heard of it being done by others except (as in a case already mentioned) on the bursa of the patella; but there can be no doubt that there are some other superficial bursæ to which it would be equally applicable if occasion called for it. I may take this opportunity of mentioning a case which shows with what facility a bursa which

has been removed may be replaced by a new one. A girl, 17 years of age, had a diseased bursa over the patella, which was removed by the late Mr. Rose, in St. George's Hospital. In less than a year afterwards she was readmitted under my care, with a similar tumour, of considerable size. I made a free incision into it with a lancet. A considerable quantity of lymph and serum escaped. The inner surface of the cyst suppurated and healed, and the patient soon afterwards left the hospital cured.

LECTURES

ON THE

DISEASES OF THE URINARY ORGANS.

THE experience which I have had since the last publication of my Lectures on the Diseases of the Urinary Organs, has not only supplied me with some additional information in this important department of Surgery, but has enabled me to correct some of the opinions which I held formerly. I have endeavoured to introduce these results, in their proper places, in the present Volume, and I hope that in doing so I have made it more worthy of the profession to whom it is offered, than the editions which have preceded it.

B. C. B., 1849.

These lectures, a portion of a regular course on surgery, originally appeared in 'The London Medical Gazette.' The first edition, in a collected form, was published in 1832; a second edition appeared in 1835, a third in 1842, and the last in 1849, to which I have added the paper on lithotrity, published in the 'Medico-Chirurgical Transactions' in 1855. This work was translated into French by M. Patron of Montpellier. It was also reprinted in America.—C. H

LECTURE I.

In this and the following lectures I propose to draw your attention to the diseases affecting the urinary organs, as far as these come under the cognisance of the surgeon.

Among all the important subjects which we are required to investigate, I know of none more important than this. These diseases are always a source of great anxiety, in many instances of pain and misery, to the patient; and for the most part, if allowed to take their natural course, they terminate in his destruction. At the same time, there is no class of diseases in which we are, on the whole, enabled to render those who suffer from them more essential service; often by removing the disease altogether; at other times by relieving the more distressing symptoms, and by prolonging, where we cannot ultimately preserve, the patient's life. I shall consider first the diseases of the urethra; afterwards those of the bladder and prostate gland. My concluding observations will relate to urinary and other calculi.

ON DISEASES OF THE MALE URETHRA.

The urethra of the male being long and narrow, complicated in its structure and functions, you will not be surprised to learn that it is liable to more numerous, as well as to more formidable, diseases than the short, wide, and simple urethra of the female. What I know of the diseases of the latter may be comprised in a few words; while those of the former will require a more lengthened investigation.

STRICTURE OF THE MALE URETHRA.

The canal of the urethra may be partially or completely obstructed in various ways.

Some of these causes of obstruction are to be looked for in the parts which are external to the urethra, and will be noticed in future lectures. At present, I shall confine my observations to those obstructions which have their origin in the urethra itself, and to which the name of stricture of the urethra is commonly applied.

The persons most liable to be affected with this disease are those who have passed the age of puberty, but have not yet passed the middle period of life. Occasionally, however, we meet with it in children; and in a few instances it begins to exist in elderly persons. It may sometimes be traced as the consequence of a severe or long-continued attack of gonorrhœa; and it is not unusual to ascribe it to the use of irritating injections administered on account of that complaint. It would seem that whatever increases the stimulating qualities of the urine, so as to make it a cause of irritation to the parts with which it comes in contact, may lay the foundation of stricture of the urethra. Thus we find it where the urine deposits the lithic-acid sand, where it is habitually overloaded with the lithate of ammonia, and still more frequently where it is alkaline, and deposits crystals of the triple phosphate of ammonia and magnesia. In some rare instances it immediately follows mechanical injury; but this last variety of the disease presents some peculiarities, which make it worthy of being considered separately.

We find a patient labouring under a difficulty in voiding his urine. It flows in a diminished stream, and the diminution gradually increases, until at last there is no stream at all, and it escapes only in drops. If the patient dies, and there is the opportunity of examining the morbid appearances, some portion of the urethra is found to be contracted, the mucous membrane, at the contracted part, being thickened and deprived of its natural elasticity. The thickening seems at first to be of the simplest kind; and we cannot explain it better than by ascribing it to an interstitial deposit of coagulated lymph (or albumen) which has become organised. If the disease has existed for many years, the

contracted portion assumes a structure approaching to that of cartilage, and the parts immediately in contact with it partake of this alteration to a greater or less extent. Another change is discovered in a more advanced stage of the disease. Instead of being confined, as it generally (though probably not always) is, in the first instance, to a small portion of the canal, the contraction extends in both directions, that is, towards the bladder and towards the external orifice, being however still more complete at the point at which it was originally established, and becoming gradually less as it recedes from it.

If we carry our researches further, we find that in the majority of instances the disease began in the anterior portion of the membranous part of the urethra, immediately behind the bulb, and in the situation of the triangular ligament of the perineum; that in some instances it had its origin in the urethra somewhere between the part just mentioned and the external orifice; and that in a few cases it is confined to the external orifice and the canal immediately adjoining to it. Occasionally, where the original and principal stricture has been in the membranous portion of the urethra, there is another stricture anterior to it; and in cases of very long standing it is not unusual to find the greater part of the canal in a thickened and contracted state.

But here, as on most other occasions, morbid anatomy affords us but an imperfect lesson in pathology; and it is only from the observation of what happens in the living body that we can learn one of the most important circumstances in the history of this disease. While in some cases there is from day to day but little variation in the size of the stream of urine, we find in others that it varies greatly, so that a patient who one day voids his urine with so much facility that he is scarcely conscious of the existence of any impediment to his doing so, on the following day may void it only in drops, or even be unable to void it at all. This change, moreover, may take place in a very short space of time. The difficulty of micturition may almost immediately follow too copious libations of those liquors which cause the urine to be loaded with

an excess of lithic acid, or lithate of ammonia; such, for example, as punch or champagne; and, as I shall explain more fully hereafter, it may subside, even more suddenly than it took place, after the pressure of a full-sized bougie against the anterior part of the stricture, or the application to it of the nitrate of silver. The permanent alteration in the condition of the urethra, which is disclosed to us by dissection, will not account for these phenomena; and we are compelled to refer them to some power of contraction, which exists in the living body, and is wanting in the dead. A multitude of facts which you will meet with in practice can be no otherwise explained; and no one much conversant with these cases will doubt that the distinction between spasmodic and permanent stricture is well founded.

What I am about to mention seems to throw some light on this subject. Spasmodic stricture is always situated in the membranous portion of the urethra, where the canal is surrounded by a sort of sphincter muscle of no inconsiderable size connected by a small double tendon to the arch of the pubes. A particular description of this muscle has been given by the late Mr. Wilson, in the first volume of the 'Medico-Chirurgical Transactions;' and it seems not unreasonable to suppose that it is the real seat of these spasmodic affections. We find nothing like spasmodic stricture in the anterior part of the canal, where there are no muscular fibres in immediate contact with it.

Instances are not wanting of persons who have been for a considerable time liable to occasional attacks of retention of urine from spasmodic stricture of the urethra, although in the intermediate periods there was no perceptible diminution of the stream of urine; and hence we are justified in the conclusion that a spasmodic stricture may exist independently of any actual organic disease. At the same time it must be acknowledged that the existence of a purely spasmodic stricture is of rare occurrence. Repeated attacks of spasmodic contraction, attended with violent efforts and straining to evacuate the contents of the bladder, cannot fail to lay the foundation of a permanent thickening of the

mucous membrane. On the other hand, there can be no doubt that what was from the beginning a permanent stricture of the membranous portion of the urethra is always more or less liable to be affected with spasm. Even in the oldest cases of this description we find the patient voiding his urine one day with tolerable facility, and another day only in drops, or even suffering from a complete retention of urine in the bladder.

A stricture which affects the external orifice and anterior extremity of the urethra is, in many cases, connected with an adhesion of the inner surface of the præpuce to the glans penis. Such adhesion is usually the consequence of a congenital narrowness of the præpuce, combined with want of due attention on the part of the nurse to the child's cleanliness; and hence it is that patients who labour under this kind of stricture frequently declare that they know not when the disease began, and that they cannot remember the time when the urine flowed in a full stream. The contraction thus established goes on increasing, but so gradually that it may not occasion a retention of urine, nor even any serious inconvenience until the middle period of life. In other cases a stricture in the anterior part of the urethra, whether situated near the orifice, or two or three inches from it, seems to be the result of a chronic inflammatory affection of the mucous membrane. There is a slight degree of pain in making water, a gleety discharge, approaching in its character more nearly to mucus than to pus, and a diminution of the stream of urine, which proceeds more rapidly than where the disease had begun in childhood; and by-and-by a gristly induration may be felt through the substance of the corpus spongiosum, marking the exact situation and extent of the disease.

A permanent stricture of the urethra cannot exist for any long period without the urethra, between the stricture and the bladder, becoming diseased otherwise. Small irregular prominences or tubercles are sometimes found on its inner surface, which seem to consist of minute deposits of coagulated lymph, which have become organised. Occasionally a narrow membranous band is

seen extending from one side of the urethra to the other, as if there had been a partial adhesion of the opposite surfaces, which had afterwards become elongated. The orifices of the mucous glands and those of the prostatic ducts are often preternaturally dilated, and indeed the whole canal of the urethra behind the stricture is widened, in consequence of the bladder forcibly impelling the urine into it, there being at the same time an insufficient outlet for its escape.

This dilatation of the urethra is most remarkable when the stricture is in the anterior part of the canal. I attended a gentleman, who for many years had laboured under a stricture at the distance of three inches behind the external meatus. The posterior part of the urethra was so much dilated, that whenever he made water, a tumour, as large as a small orange, and offering a distinct fluctuation, presented itself in the perineum. It might be compared to a second bladder. Once, when he sent to me, labouring under a complete retention of urine, I punctured the tumour in the perineum with a lancet. Immediately the urine gushed out in a full stream. From that time it flowed regularly through the artificial opening; all difficulty in voiding it was at an end; and thus I was enabled to direct my whole attention to the dilatation of the stricture, which was now speedily accomplished.

In some cases of long standing, we find an indurated mass at the lower portion of the penis, where it is covered by the scrotum, and extending from thence backwards into the perineum. This arises from the conversion of the contracted portion of the urethra, and of the textures in immediate contact with it, into a gristly substance, approaching in hardness to cartilage. The following case explains how a tumour a good deal similar to this may be formed in some instances. A gentleman who had passed many years in a hot climate returned to England, labouring under a stricture of the urethra, and voiding his urine with great difficulty. A hard oblong tumour could be felt in the neighbourhood of the stricture, though somewhat anterior to it, at the upper part of the scrotum. I dilated the stricture, so as to enable the patient to introduce a bougie for himself; but still the tumour remained unaltered. He

died about a year afterwards of an accidental attack of disease in the brain; and I found, on dissection, that the tumour had arisen from a deposition of lymph in the cells of the corpus spongiosum. Immediately behind the stricture there was an orifice, leading into a long and narrow sinus, extending from the urethra into the gristly substance of the tumour. The direction of the sinus was from behind forwards, so that it was evident that it could not have been produced by the improper use of the bougie. I conclude that it was the result of the forcible and repeated pressure of the urine against the urethra behind the stricture. The same cause, of course, was sufficient to produce the gristly induration around it.

In the foregoing observations, which have been intended chiefly to illustrate the pathology of stricture of the urethra, I have necessarily anticipated some of the observations that I have to offer respecting the symptoms by which it is indicated in the living person, and the diagnosis of the disease.

If a man under the middle period of life applies to you, complaining of a difficulty of making water, the probability is that he labours under a stricture of the urethra. If an old man applies to you under the same circumstances, stating at the same time that his symptoms began several years ago, you may draw the same conclusion. But if he tells you that his symptoms are of later origin, you will have little reason to suspect the existence of stricture of the urethra, but great reason to believe that he labours under an enlargement of the prostate gland. Stricture of the anterior part of the urethra, for the most part, proceeds very slowly; so that the patient, in some instances, scarcely notices the diminution of the stream of urine until he is actually compelled to strain in voiding it. A complete retention of urine does not occur until a very late period of the disease; and whenever it does occur, it is scarcely ever relieved spontaneously, that is, without the assistance of art. In these cases there is generally a slight sense of scalding as the urine flows; and a mucous or muco-puru-

lent discharge is a frequent, but not invariable, concomitant of the other symptoms.

In cases of stricture affecting the membranous portion of the urethra, where the disease in its origin is purely spasmodic, it may be that the patient's attention is first drawn to his complaint in consequence of his being suddenly affected with a complete retention of urine, induced by some irregularity as to diet, exposure to cold, or perhaps by the application of a blister. But in another and much more common series of cases the history is nearly as follows. The patient voids his urine in a diminished stream. The diminution gradually increases, being sometimes attended with a slight mucous or muco-purulent discharge. By-and-by there is a complete retention of urine. This subsides spontaneously, or is relieved by art. After an interval (which may vary from weeks to months, or even to years), he is overtaken by another attack of retention. During the whole of this time, the stream of urine continues to become smaller; it is flattened, or otherwise altered in shape, or divided into two. At last the urine never flows in a stream larger than a thread, nor without great effort and straining. In some cases it dribbles away constantly and involuntarily, and the patient's clothes by day and his bed at night are absolutely sopped with urine, making him disgusting to himself and to all around him. This involuntary discharge of urine does not indicate an empty and contracted bladder. The bladder, in fact, is loaded with urine, and it is when it does not admit of further distention that the urine overflows, all beyond a certain quantity escaping without the patient being able to prevent it, the bladder being at the same time to be felt like an enormous tumour in the lower part of the abdomen. The exceptions to this rule are very rare; and it applies not only to the involuntary flow of urine in cases of stricture, but also to that which takes place under other circumstances.

The symptoms of retention of urine are sufficiently formidable, and not the less so as they generally attack the patient suddenly. He is perhaps sitting with his friends after dinner, and feels an

inclination to make water. In attempting to do so, however, he is disappointed. A second and third attempt are made after some time, and all without success. Now the case assumes a more serious aspect. An indescribable uneasiness is felt in the region of the bladder. The efforts to void the urine are no longer voluntary. The patient is compelled to strain, and the whole of the abdominal muscles are in convulsive action, instinctively endeavouring to relieve the bladder of its contents, but still to no purpose. The bladder may be felt hard, and enlarged above the pubes. The heart sympathises with the local irritation, the pulse is hard and frequent, the face flushed, the skin hot, and the tongue is covered with a white fur. The violent efforts of the patient force out a few drops of urine, which give some relief; but the kidneys go on secreting, and the relief is only temporary. In the great majority of cases the spasm is spontaneously or artificially relieved; but there are, nevertheless, numerous examples to the contrary, in which the retention terminates in death. The bladder itself may be ruptured at the fundus, the urine escaping into the cellular membrane, or even into the cavity of the peritonæum. Such an event occurred in St. George's Hospital many years ago. The patient exclaimed, after a violent paroxysm of straining, that the bladder had burst into the belly. He died; and, on examining the body, it was ascertained that the poor fellow's words were true. This case, and another similar one, have been published by Sir Everard Home. Fortunately, such cases are rare.

In most instances, the rupture is not of the bladder, but of the urethra behind the stricture. Conceive a distended bladder, and the abdominal muscles and diaphragm of a powerful man acting like a syringe, and forcing the urine through the lacerated urethra into the cellular membrane. In a short space of time the scrotum, the penis, the perineum, sometimes even the groins, are enormously distended with urine. The first effect of this mischief is to relieve the patient's sufferings. There is no more straining, and the spasm of the stricture, no longer excited by the pressure behind, becomes relaxed, so as to allow some of the urine to flow by the natural

channel. After this deceptive interval of ease, another order of symptoms shows itself. The urine, under any circumstances, would irritate the parts unaccustomed to its contact; but in a case of retention of urine, it has been long in the bladder; much of its watery part has been absorbed; and it is in consequence unusually impregnated with saline matter, so that its stimulating properties are greatly increased. Wherever this acrid fluid penetrates, it first excites inflammation, and then kills the parts with which it is in contact. The patient is seized with shivering; the skin of the scrotum, penis, and other parts becomes red and inflamed. If you make incisions into it, you find black offensive sloughs underneath. If the incision be not made, or be not sufficiently extensive, the skin becomes speckled with black spots, which increase in size, forming large sloughs. Sometimes a black spot is seen on the glans penis: an almost fatal symptom, indicating that the whole of the corpus spongiosum is infiltrated with urine. As the process of mortification goes on, the constitution becomes affected, as it would have been if the mortification had arisen from any other cause. At first the pulse is full, and the skin hot; but the depressing effects of an extensive destruction of living parts are soon manifest. The heart beats feebly and frequently; then the pulse becomes irregular, and afterwards intermittent. The skin is cold and clammy; the patient is troubled with an incessant hiccough, which nothing relieves for more than a few minutes. By-and-by, a low delirium supervenes, which is followed by coma and death.

But the danger from the effusion of urine is not the same in all cases. In the majority the effusion takes place in front of the triangular fascia of the perineum, or else the fascia gives way and allows the urine to pass forward to the superficial parts, instead of penetrating to the deep-seated; and under these circumstances life may generally be preserved by the prompt interference of the surgeon. In a very few cases the effusion extends into the loose cellular membrane which surrounds the bladder, and the patient's condition is hopeless.

The time during which a retention of urine may continue before a rupture of the urethra or bladder takes place, is much longer than you would expect. Such a catastrophe as that which I have endeavoured to describe rarely occurs before the third or fourth day. It may, indeed, occur sooner; but often the period is even later than this. The retention may continue for a week, with occasional intermissions, during which small quantities of urine are discharged; then it may become complete, and, the urethra giving way, the urine may be extravasated. The secretion of urine may be more or less abundant: the bladder may be more or less capable of dilatation: and the period of the extravasation taking place must vary accordingly.

I am much mistaken if a stricture is not sometimes destroyed, at least in part, by ulceration. For example: I attended a gentleman who had laboured under a stricture of the urethra for a great many years. He voided his urine with the greatest difficulty; the stricture being very rigid and unyielding: but I succeeded in introducing a catgut-bougie, and this enabled him to make water in a small stream. Under these circumstances he was seized with pain in the act of making water, which lasted for some minutes afterwards, being referred to the situation of the stricture in the posterior part of the urethra. The pain became more severe, and the patient described it to be intolerable, saying that he could compare it to nothing but the sensations which he supposed might be produced if melted lead were poured into the canal. Every half hour he had a desire to make water, and his groans might be heard, not only through the whole house, but even in the street. In the course of a few days these symptoms began gradually to abate, and now it was discovered that the urine flowed in a much larger stream. When the attack had completely subsided the condition of the patient was much improved, and he made water more easily than he had done for many years. I know not how all these circumstances can be so well explained as on the supposition of the stricture having been in a state of ulceration.

Such a case is rare; but what I am about to describe is common

enough. The patient complains of more than usual difficulty in voiding his urine; but the difficulty does not amount, at least in the first instance, to an absolute retention. Perhaps he has a shivering. There is a sense of fulness in the perineum and some degree of deep-seated induration is perceptible in one part. This gradually increases, and a tumour presents itself under the skin of the perineum, surrounded with more or less of œdematous effusion, especially into the scrotum. The skin becomes inflamed, and the fluctuation of fluid is perceptible underneath. An abscess bursts, or is opened with a lancet, and a considerable quantity of putrid pus is discharged. Then the œdema of the neighbouring parts subsides. Pus continues to flow through the orifice of the abscess, and after some time it is observed that urine flows through it also. The discharge of pus diminishes, but the urine flows in larger quantity; and whenever the patient makes water, part escapes through the natural channel and part by the new opening. The abscess has evidently a communication with the urethra behind the stricture. If you have an opportunity of dissecting the diseased parts while the abscess is recent, you find it to open into the urethra by a ragged irregular orifice. If you examine them at a later period the orifice in the urethra is found to be smooth, regular, and rounded at the margin; the external orifice in the perineum is reduced to a narrow diameter, and is seen in the centre of a button-like projection of the skin; and the abscess itself is contracted, perhaps reduced to a narrow passage, with a smooth surface which presents somewhat of the appearance of its being lined by a mucous membrane. We now say that the case is one of fistula in perineo. The whole of these phenomena are easily explained. The urethra, constantly teazed by the pressure of the urine against it, ulcerates behind the stricture. If the stricture had been completely closed, as in a case of retention of urine, an extensive extravasation of urine would have immediately taken place; but under the existing circumstances this does not happen, and only a moderate quantity, perhaps not more than a few drops, dribbles into the cellular membrane, sufficient to induce inflammation and suppuration, and no

further local mischief. A fistula in ano is formed in the same manner, by ulceration of the rectum allowing the escape of a minute quantity of fæculent matter into the neighbouring textures.

The formation of the abscess in the perineum is always attended with some degree of fever. But sometimes the febrile symptoms are very urgent: the skin is hot, the pulse rapid, the tongue dry and brown, or covered with a black crust. If the abscess be left to burst of itself, it is more than probable that the patient will perish under these typhoid symptoms; if it be opened, a dark-coloured offensive putrid pus is discharged, the bad qualities of which are manifestly owing to an admixture of urine. If the operation be not imprudently deferred, an immediate improvement follows the opening of the abscess. The first effect is that the retention of urine is relieved; then the pulse becomes less frequent, the skin less hot, the tongue clean and moist, and the patient, who appeared to be on the verge of death, is restored to life, and comparatively to health.

I have described the simplest form of the urinary abscess. But it is often more complicated. It is not always confined to the perineum. Sometimes it makes its way forward through the upper part of the scrotum, and presents itself on the lower part of the penis, between the scrotum and the glans. At other times it burrows in the opposite direction, forming a large collection of matter in the nates, or it may burst in the groin or on the scrotum. In one case, in which I had the opportunity of examining the body after death, I found a large abscess in front of the pubes, extending half way towards the navel; another among the adductor muscles of the left thigh; and a third among the muscles at the upper part of the right thigh, as far outwards as the foramen ovale of the ischium; the periosteum having been destroyed, and the bone itself rendered carious to a considerable extent: and all these abscesses could be traced into an abscess in the perineum, communicating with the urethra behind a stricture by a small orifice. In another case which I attended with Mr. Samuel Cooper, there

was a fistula in perineo, communicating with a large abscess of the pelvis on one side of the bladder.

I have seen a few cases in which an abscess of this kind had made its way into the rectum, forming a fistulous communication between it and the urethra. If such communication be of a large size it is a source of great distress, as fæculent matter occasionally passes through it from the rectum into the urethra. If it be small, however, the absolute inconvenience is trifling, and the patient is rendered sensible of its existence only in consequence of a small quantity of air escaping occasionally by the urethra: and this may continue, without any further symptoms supervening, for many years.

A gentleman who had laboured under a stricture of the urethra, and had been in the habit of introducing bougies, but who had never before suffered from any very urgent symptoms, began to complain of pain referred to the situation of the rectum. The pain gradually became very intense, coming on by fits, and under these circumstances I was called in to see him. On examination I discovered a collection of fluid in front of the rectum, between it and the prostate gland, bladder, and urethra. After a few days the tumour gave way, and a large quantity of pus was discharged by the rectum. The painful symptoms were now relieved, but pus was found from time to time in the evacuations from the bowels. Then another abscess presented itself in the perineum, which I opened. The patient remained quiet in the recumbent posture, the urine was drawn off once daily by means of a full-sized silver catheter, and, except what was required on account of his general health, no other treatment was had recourse to. The discharge of pus both by the rectum and by the perineum gradually ceased, but occasionally the patient experienced some uneasy feelings referred to the neck of the bladder, and attended by febrile disturbance of the system, and followed in the course of a few days by a deposit in the urine having the appearance of pus tinged by fæculent matter. I saw the patient three years afterwards apparently well

and following his usual pursuits, but still occasionally suffering from attacks similar to those last mentioned.

There is one form of abscess of the perineum, which may be compared to what has been called a blind fistula of the rectum; the abscess having an opening into the urethra and none externally. Such an abscess may at one time be inflamed, swollen and tender; then these symptoms may subside, but only to recur at a future period; and this state of things may continue for many years. I conclude that in these cases the abscess is formed in the usual way, by ulceration of the urethra and the infiltration of a small quantity of urine into the cellular texture; but that, when a certain quantity of matter is collected in it, it bursts into the urethra, instead of finding its way to the surface, the communication being of sufficient size to prevent any considerable accumulation of matter afterwards.

A fistula of this description is a source of inconvenience and mischief, and of nothing else. It is not so with a fistula which has an external opening. The latter answers, in some measure, the purpose of a safety-valve to the bladder, enabling the patient to void his urine even where the stricture is closed, and lessening the liability to retention. But even in this case the good is not unmixed with evil. It occasionally happens that the external orifice of the fistula becomes inflamed and swollen, or that it actually heals, and that this is followed by an accumulation of matter within, attended with many, or with the whole, of the symptoms which marked the first attack of the disease. And there may be even greater mischief ultimately. Mr. Vincent and myself attended a gentleman with a fistula in perineo, which he had neglected for many years. At last he observed that the callosity at the margin of the fistula had begun to increase; and it went on increasing, so that it ultimately extended to the scrotum and penis. When we were consulted, we found him with a malignant tumour, affecting the perineum, scrotum, and penis, which had evidently had its origin in the fistula. He ultimately died in great distress and misery.

LECTURE II.

STRICTURE OF THE URETHRA—*continued.*

If you consider the relations which the urethra bears to the prostate gland and bladder, you will not wonder that these organs should suffer in old and inveterate cases of stricture.

A chronic enlargement of the prostate gland is one of the most frequent changes with which the body is affected in old age; and it may take place in those who labour under stricture of the urethra as well as in other persons. There is, however, more than this merely accidental connection of the two diseases with each other; and those who have been long tormented with stricture are more liable to disease of the prostate, and are liable to it at an earlier period of life, than those in whom the urethra is free from obstruction. In a great number of instances, where the patient is somewhat advanced in years, when you have dilated the stricture you find that the relief is incomplete, and remedies, beyond those which the stricture itself demand, are necessary to remove or palliate the symptoms produced by the disease of the prostate. I have already mentioned the dilatation of the ducts of the prostate, which is observed in some cases. Occasionally, where the urethra has been diseased for a long period, pus may be squeezed out of the dilated ducts. Circumscribed abscesses also form in the substance of the prostate, which, in some instances, burst and discharge their contents by the urethra, during the patient's lifetime; while in others their existence is not ascertained until an incision is made into the diseased gland in the examination of the body after death. It is not my intention at present to enter into the history of the additional symptoms which arise from this

complication of disease of the prostate in old cases of stricture, since they do not materially differ from what we observe where the prostate is alone affected; to which subject I shall call your attention in a future lecture. The following observations, however, may be introduced now better than hereafter:—

1. Where a simple chronic enlargement of the prostate gland supervenes on stricture of the urethra, the latter usually becomes less liable to spasm, and is more easily dilated, and altogether more tractable than it was before: a change in its condition which is easily explained; as the pressure of the urine against the stricture when the patient strains in making water is a constant source of irritation, which is in great measure removed as soon as a new impediment to the flow of the urine between the stricture and the bladder is established by the tumour of the prostate.

2. But where the disease of the prostate goes beyond a mere enlargement, and suppuration has taken place in its substance, an opposite effect is produced on the stricture; the abscess itself becoming a source of irritation, rendering the stricture more sensitive and more liable to spasm than it would have been otherwise.

3. Although the combination of stricture with enlarged prostate is common enough, it is not so common as it is by some surgeons supposed to be. An old man, who has a frequent desire to void his urine, and voids it slowly and with difficulty, applies to a surgeon whose hand is light and accustomed to the use of the catheter. The instrument is then introduced readily, or, at any rate, meets with no obstruction until it reaches the neck of the bladder, and the case is set down as one of enlarged prostate, which it really is. Another old man, under precisely similar circumstances, applies to a surgeon, who uses the catheter rudely and incautiously. The urethra resents this rough usage; spasm is induced, and the point of the catheter cannot be passed further than the membranous part of the urethra. The case is then supposed to be one of stricture, and is treated as such: I need not tell you to how little purpose.

I have already mentioned that the bladder is rendered irritable

in many cases of stricture of the urethra. In consequence of this it is never properly dilated, and it becomes small and contracted. If the stricture be dilated before any further disease in the bladder is established, the latter is relieved, and soon regains its natural capacity. In many cases of old and neglected stricture, the mucous membrane of the bladder becomes affected with chronic inflammation. It secretes a ropy adhesive mucus, which clings to the bottom of the vessel which receives it; and sometimes this mucus is generated in such abundance as to obstruct the narrow orifice of the stricture, and add very much to the difficulty of making water. In such cases, if you examine the body after death, you find the vessels of the mucous membrane turgid with blood, and the whole membrane, in consequence, of a dark red colour: and things may continue in this state, sometimes better and sometimes worse, for months, and even for some years.

I have met with several cases of stricture of the urethra in which the mucous membrane of the bladder was found, after death, not only inflamed, but encrusted, even over a large portion of its surface, with coagulated lymph. Such an effusion of lymph is the result of acute inflammation, differing in its character from the chronic inflammation which produces merely a secretion of the vesical mucus; and it is observed chiefly (if not exclusively) when the patient has died after having been harassed by repeated attacks of retention of urine. In these cases, if the patient survives even for a moderate period of time, the effused lymph becomes covered with an earthy deposit (the phosphate of lime). In a patient who had for many years laboured under a stricture of the urethra, and who died in St. George's Hospital, some time after an attack of retention of urine, the muscular tunic of the bladder was found thickened and contracted, and the mucous membrane in the state of slough, with phosphate of lime deposited in it.

There are other cases in which the bladder, instead of being contracted, is rendered more capacious than natural; the patient never emptying it completely. I have already explained that this condition of the bladder is often indicated by an involuntary

discharge or incontinence of urine. Here, when you have dilated the stricture, the symptoms are only partially relieved; and on introducing the catheter, you find a large accumulation of urine which the patient has been unable to void by his natural efforts. This particular symptom may occur where the stricture exists in combination with enlargement of the prostate; but it occurs also in old cases of stricture, independently of this complication.

In most cases of stricture the muscular coat of the bladder is thicker and stronger than natural. This circumstance is easily explained. The bladder has been called on to make unusual exertions, and it is a law of the animal economy, that muscles which are unusually exercised become increased in bulk.

In some instances the mucous membrane is protruded through some of the interstices of the muscular fibres, forming numerous small cysts, communicating with the cavity of the bladder. These cysts appear to be produced in the following manner:—when the patient strains in making water, the mucous membrane, while it is pressed on by the muscular fibres externally, has to sustain an equivalent degree of pressure on its inner surface from the reaction of the urine. Wherever there happens to exist a small interstice between the muscular fibres, the latter force alone operates, and the bulging out of the mucous membrane is the necessary consequence. These cysts, however, are not peculiar to cases of stricture of the urethra, and they occur equally where the obstruction to the flow of urine arises from an enlargement of the prostate gland, or from any other cause. A cyst being once established continues to increase, and may ultimately attain a very large size. Many years ago I met with a case of long-neglected stricture of the urethra, in which, on examining the body after death, I found one of these cysts interposed between the bladder and rectum, at least equal in capacity to the bladder itself. Occasionally, as I shall explain to you more fully in a future lecture, a calculus finds its way into one of these cysts, increases in size, and becomes impacted in it. For the most part, the contents of the cysts are similar to those of the bladder itself; but I shall have occasion hereafter to mention

a case in which a large cyst of this description contained pure pus, while in the bladder there was nothing but urine.

In cases of stricture, where the disease has existed for many years, and nothing effectual has been done for its relief, abscesses form in the cellular membrane external to the bladder, but communicating with it, similar to those which I have already described as connected with the urethra. A considerable time elapses before such abscesses present themselves externally. They point at last in the groin, or above the pubes, discharging a putrid offensive pus in the first instance, and giving exit to urine afterwards. In Dr. Hunter's Museum (which is now in Glasgow) there is a preparation exhibiting an abscess of this kind communicating with the bladder at the fundus, extending upwards in the course of the urachus, and opening externally at the navel. I believe that the formation of these abscesses is always preceded by chronic inflammation of the mucous membrane of the bladder, and their existence is marked by severe typhoid symptoms. They probably are the result of small ulcerations of the mucous membrane, allowing the escape of minute quantities of urine into the surrounding cellular texture, thus resembling abscesses of the perineum in their origin. They are to be regarded as a very unfavourable symptom, the patient rarely surviving long under these circumstances.

As stricture of the urethra impedes the flow of urine from the bladder, so it cannot but interfere, to a certain extent, with the passage of urine into it. One result of this is, that the ureters, pelves of the kidneys, and infundibula become dilated, the glandular structure absorbed, and the whole organ converted into a membranous bag, divided by septa into different compartments, which however communicate with each other. The kidneys are also liable to be affected in other ways; but, to avoid a needless repetition, I may refer you for what I have to say on this subject to future lectures, especially to those on the diseases of the prostate gland.

I have said that rigors sometimes occur during the formation of urinary abscesses. In this there is nothing remarkable, as rigors

mark the existence of suppuration under a variety of other circumstances. But rigors also occur in many cases of stricture independently of abscess. We meet with them most frequently in patients from hot climates. They usually recur at irregular periods, being in many instances brought on by the introduction of a bougie, or the application of caustic to a stricture. The paroxysm very nearly resembles that of an intermittent fever, and it is more severe when it follows the use of a bougie than when it occurs independently of it. In general, the cold fit having been followed by a hot fit, and that by a profuse perspiration, the patient is relieved. At other times, however, the constitution is disturbed for a great length of time afterwards; and sometimes the rigor is followed by an attack of continued fever, which lasts for some days, or even for some weeks. I met with a case in which a rigor followed the application of caustic to a stricture, and this was followed by an attack of mania, which (if my recollection be accurate) did not subside for nearly a month. Another patient had laboured under a stricture of the urethra for many years, during which time no instrument had ever been made to enter the bladder. I succeeded in introducing a small gum catheter. Having emptied the bladder, I removed the catheter. In a few hours afterwards there was a severe rigor. An attack of fever ensued, attended with rheumatic inflammation of the muscles of the neck, from the effect of which the patient never entirely recovered, though he lived for many years afterwards.

It has been said that stricture of the urethra lays the foundation of disease of the testicle. The introduction of a bougie will sometimes induce acute inflammation of that organ, probably by irritating the verumontanum and the orifice of the vas deferens; and it is not improbable that chronic inflammation of the testicle may sometimes arise in the same manner. It appears to me, however, that the effects of a stricture on the testicle have been, by some writers, very much exaggerated. An hospital surgeon, who is now no more, published a work in which he expressed himself as if he regarded almost all cases of chronic inflammation of the testicle

as being dependent on disease of the urethra, and not curable, except under the use of the bougies. I need make no comment on such a fantastic hypothesis.

DIAGNOSIS IN CASES OF STRICTURE OF THE URETHRA.

I shall now suppose that a patient applies to you, believing that he has a stricture of the urethra. Perhaps you find on inquiry that the symptoms are equivocal; and you require something more than a mere knowledge of them to enable you to determine whether a stricture does or does not exist: or it may be that the symptoms are so distinct and well-marked that you can have no doubt as to the existence of a stricture, but you wish to know in what part of the urethra it is situated, aud what is the degree of contraction. The knowledge that is required in either of these cases is to be obtained by the examination of the urethra with a bougie, or some other instrument corresponding to it.

The best kind of bougie is that in common use, made of plaster spread on linen, and rolled up. It should be smooth on the surface, and neatly rounded at the extremity. The plaster bougie should be rubbed until it becomes warm, so that it may be moulded by the hand, and bent into the form of the urethra. Thus bent, it is much to be preferred to the elastic bougie, which is made of elastic gum on the outside and of catgut within. The latter may, it is true, be bent into any form; but it is elastic, and however you may bend it, it always regains its straight figure; and hence it is not well constructed for being passed along the curved canal of the urethra. The bougie which is used for the purpose of examining the urethra should be of a full size, that is, large enough to fill the urethra without stretching it. A small bougie may deceive you in two ways: it may pass through a stricture, and thus lead you to believe that there is no stricture, when there really is one; or it may have its point entangled in the orifice of one of the mucous follicles of the urethra, or in some accidental irregularity of the canal, and lead you into the opposite mistake of supposing that there is a stricture where none exists. If you use a

bougie of the size of the urethra you are not at all liable to the first error, and you are much less liable to the second than you would be otherwise. The bougie should be cylindrical. There is no advantage in any bougie, except a very small one, being conical. A conical bougie becoming larger towards the point, which is held in the hand, is likely to extend forcibly the orifice of the urethra, and to excite inflammation in it.

The existence of stricture in the anterior part of the urethra, or at its orifice, is so easily ascertained that it seems unnecessary to offer any observations on the subject. The following rules, then, are to be considered as relating especially to those cases in which it is a question whether there be or be not a stricture in the membranous part of the urethra, or in its immediate vicinity.

I generally find it best to introduce the bougie previously moulded to a proper form (that is, slightly bent towards the point), the patient being in the erect posture. If, however, he be inclined to faint, he may be recumbent on a sofa. I keep the extremity of the bougie which I hold in my hand near the patient's groin, passing it until it will go no further in that direction; after which, by turning the instrument, I bring it horizontally forwards, and push it gently towards the bladder. If the patient has well-marked symptoms of stricture, and the bougie meets with an obstruction in some part of the urethra, you may be justified in considering this as sufficient to indicate the existence and situation of the disease. If, however, the patient has no such well-marked symptoms, you should not advance at once to the conclusion that there is a stricture because the bougie does not immediately enter the bladder. The extremity even of a large bougie may hitch in some irregularity of the mucous membrane; or if you are at all rough in the use of it, a spasm may be induced in the membranous part of the urethra, or in the muscle which surrounds it, preventing the bougie from being passed, although no such cause of obstruction exists at other times. Under these circumstances you should introduce a silver catheter, or, what is better, a metallic sound, having a moderate curvature, and warmed to the temperature of the body;

and it is probable that, if there be no stricture, the metallic instrument will be easily introduced, although the plaster bougie could not be introduced at all. In short, where there are no decided symptoms of stricture you ought not to adopt the opinion that a stricture exists without having made a very careful examination of the urethra by more than a single method. Inattention to this rule has led to many patients being subjected to a course of treatment for stricture who had never laboured under the disease.

There is a fashion in diseases, or rather (to speak more properly) there is a fashion in the opinions entertained as to the prevalence of particular diseases, and when the attention of the medical profession and the public has been especially directed to a certain order of cases, such cases are almost invariably supposed to be much more common than they really are. A very few years ago it was so with respect to the disease which we have now under consideration. If a man had a troublesome gleet; if he had an indurated testicle; if he had a priapism at night; if he had a frequent inclination to void his urine; if he was impotent, or believed himself to be impotent; if the stream of urine was not perfectly cylindrical; or even if he was liable to an herpetic eruption on the prepuce; he was supposed by many surgeons to be labouring under stricture of the urethra, and was at once subjected to the unnecessary use of bougies. The number of persons who at this period were supposed to have a stricture of the urethra, and who really had no such disease, many of them indeed having no disease, at all, was not less than that of the young females who, at a still later period, have been the victims of another mischievous delusion, being laid up for years together on a sofa, under the supposition that they laboured under disease of the spine or hip, when in reality they suffered only from hysterical pains and spasms, which air and exercise would have cured, but which confinement and nursing, and the attendance of physicians and surgeons, and anxious friends, have only tended to aggravate. I dwell on this subject because I am anxious that none of my pupils should fall into an error so discreditable to themselves, and so mischievous to society.

TREATMENT OF A RETENTION OF URINE FROM STRICTURE.

It frequently happens that when you are first called to a patient with a stricture of the urethra it is on account of his labouring under a retention of urine in the bladder. At all events, this, when it does occur, demands your first attention. Here the patient is in a state of immediate danger; and you are to stand between him and destruction. You have no time to pause, to deliberate, or to consult your friends or your books. Your patient is suffering torture; he and his friends are in a state of the greatest possible anxiety and alarm; and it is important that you should have a perfect knowledge of all the remedies which are likely to be useful, so that you may be enabled to make an immediate application of them for his relief.

You will observe that the causes of retention of urine are various. Stricture of the urethra is only one of them. The treatment which is applicable to a retention from one cause is not applicable to a retention from others. The observations which I am about to make relate exclusively to cases of retention from stricture: but even in these cases the immediate cause of the inability to void the urine is not always the same.

I have explained how it is that abscess is formed in the perineum. Here, in the first instance, there has been no absolute retention of urine. If there had been, instead of an abscess, there would have been an extensive extravasation of urine into the cellular membrane. But when an abscess is once formed in the neighbourhood of the urethra, and has attained a certain magnitude, it cannot fail to obstruct that canal, and, though not the consequence, may itself become a cause of a complete retention of urine. This is especially liable to happen where the matter is pent up behind the deep-seated fascia of the perineum. To relieve the retention you must open the abscess. For what I have to say further on this subject, I may refer you to my next lecture.

A stricture at the external orifice, or in the anterior part of the

urethra, is a much less frequent cause of retention of urine than a stricture which is situated at the membranous part. Here the stricture is not liable to spasm, and you can look only to its mechanical dilatation. A small catgut bougie may generally be introduced into it. This may be followed by one of a larger size, and this again by a straight metallic instrument larger still. This will enable the patient to void a portion, but not the whole, of his urine. The bougie or metallic sound must then be introduced again, and allowed to remain in the stricture until there is another impulse to make water, and this process must be repeated until the bladder is emptied.

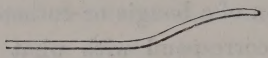
But in the very great majority of cases the immediate cause of a retention of urine is a spasmodic affection of a stricture at the membranous part of the urethra; and it is to this class of cases that the observations which I have now to offer will especially relate.

I have heard it recommended, even by some experienced surgeons, that in these cases you should bleed your patient, that you should direct him to be put into the warm bath, and that certain other means should be employed, before you attempt to relieve him by the introduction of a bougie or catheter. But this recommendation does not correspond with what my own experience would suggest. The immediate cause of the retention is local, and in the greater number of cases you will succeed in enabling the patient to empty the bladder by mechanical means. The plan which I would recommend you to adopt is the following:—

Begin by taking one of the smallest gum catheters, which has been kept for a considerable time on a curved iron wire, and which retains the curved form after the wire is withdrawn. Introduce it without the wire; and, as it approaches the stricture, turn the concavity of the catheter towards the pubes, elongating the penis at the same time by drawing it out as much as possible. It is not very improbable that it will pass through the stricture, and enter the bladder. The urine will then flow through it in a

fine stream, and the patient will obtain immediate and complete relief.

If you fail with the small gum catheter, try, not a plaster, but a small catgut bougie. Let this be well made; that is, firmly twisted, nicely rounded at the extremity, and everywhere well polished. Observe the same rule of elongating the urethra, and it will probably enter the stricture. It is not necessary that the catgut bougie should pass on to the bladder; it is sufficient if the stricture grasps, or holds it. The contraction of the stricture on the bougie seems to exhaust its irritability, and lessen the disposition to spasm. Let the bougie remain in the stricture until there is a violent impulse to make water; then withdraw it, and the urine will follow in a small stream. If the patient empties the bladder, the object is attained; but, otherwise, re-introduce the catgut bougie, or rather introduce another of the same size (for a catgut bougie which has been once used is not fit to be employed a second time); and let the patient retain this second bougie as long as he can. If the straight catgut bougie cannot be passed, you will often succeed in effecting its introduction by bending the point of it thus :—



This contrivance enables you to keep the point sliding against the upper surface of the urethra, avoiding the lower part, in which the obstruction is always most perceptible, and in which the bougie is most likely to become, as it were, entangled.

Even where you have failed to relieve the patient by means of the catgut bougie, you will often succeed in introducing a silver catheter, or an elastic gum catheter mounted on a firm iron stilet, into the bladder. The catheter employed on this occasion, if the stricture be of recent formation, should be nearly of the full size of the urethra; but if the stricture has been of long duration, it should be considerably smaller. The common silver catheter is not so well adapted for the purpose as that which I now show you.

You will observe that it is shorter and less curved than usual; and that it is fixed in a wooden handle, which renders the instrument more manageable than it would be otherwise. If you use an elastic gum catheter, the iron stilet should have a flattened handle, resembling that of a common sound. You should pass it as far as the obstruction, and having ascertained where it is situated, withdraw the catheter a little, a quarter of an inch for example, and then, as you pass it on again towards the bladder, keep the point sliding against the upper part of the urethra, which is towards the pubes, avoiding the lower part, which is, of course, towards the perineum. Be careful to employ no violence. If you lacerate the urethra, so as to cause hæmorrhage, you will be defeated in your object. Press the catheter firmly, but gently and steadily, against the stricture, keeping in your mind the anatomical position of the parts, and being careful to give the point of the instrument a right direction. When the pressure has been thus carefully continued for some time, the stricture will begin to relax. It will allow the point of the catheter to enter, and, at last, to pass completely through it into the bladder. In some instances this will be accomplished in the space of one or two minutes; while in others it may be necessary to persevere for a quarter of an hour. As soon as the catheter has reached the bladder, the patient's sufferings are at an end, as the bladder becomes completely emptied. If you have used the elastic gum catheter, it may be prudent to allow it to remain in the urethra and bladder for one or two days, or even for a longer period; and this will go far towards accomplishing the cure of the stricture. In cases of more than usual difficulty, I have sometimes been induced to leave the silver catheter in the bladder for one or two days, but, for obvious reasons, it is not so well adapted for this purpose as the more flexible instrument.

If you are skilful and prudent in the management of the catheter, you will generally succeed in introducing it into the bladder; but if you fail in doing so, the attempt to introduce it may still be useful to the patient. The pressure of the catheter against the stricture, if kept up for a considerable time, exhausts

the morbid irritability of this diseased portion of the urethra. The spasm becomes in a considerable degree relaxed, and if you withdraw the instrument when the patient has a violent impulse to make water, the urine will follow in a stream. Observe, that I am taking it for granted that you are careful to avoid all violence. If the membrane of the urethra be lacerated, the probability is, that the spasm will not give way; and if, under these circumstances, you persevere in the attempt to introduce the catheter, you will but aggravate the evil which it is your object to remove.

The remedy on which you are most to rely, where these mechanical means fail, is opium. From half a drachm to a drachm of laudanum may be given as a clyster in two or three ounces of thin decoction of starch. If this should not succeed, give opium by the mouth, and repeat the dose, if necessary, every hour until the patient can make water. According to my experience, the cases in which the stricture does not become relaxed under the use of opium, if administered freely, are very rare. The first effect of the opium is to diminish the distress which the patient experiences from the distention of the bladder. Then the impulse to make water becomes less urgent; the paroxysms of straining are less severe and less frequent; and after the patient has been in this state of comparative ease for a short time, he begins to void his urine, at first in small, but afterwards in larger quantities.

It is customary in these cases to employ the warm bath. It is, indeed, sometimes useful, but you can place no dependence on it as compared with opium. It is not sufficient that your patient should sit in a hip-bath: the bath, to be at all efficient, must be complete; his whole person ought, therefore, to be immersed, and he should remain in it for half an hour, or an hour, or longer, unless he previously becomes faint. Bleeding from the arm is seldom required in cases of retention of urine from stricture; but, in some instances, even where other means have failed, taking blood from the perineum, by cupping, gives immediate relief. Even dry-cupping may be useful; for I have known the spasm of

a stricture to be relieved on the first application of the cupping-glass, and before that of the scarificator.

Purgatives require some time to produce their effect, and, in most cases, at the period of your being called in, the symptoms are too urgent to admit of this delay. Where, however, a stricture is chiefly spasmodic, and the retention follows the too great use of fermented liquor or spirits, I would advise you, if you are sent for on the commencement of the attack, to prescribe a draught of infusion of senna, with the tartrate of potass and tincture of jalap. As soon as this has fully operated, and the bowels are emptied, give thirty or forty drops of tincture of opium by the mouth, or order an opiate clyster to be administered, and, in all probability, the attack will subside.

After all, there is no absolute rule as to the treatment of retention of urine from stricture. One person is relieved in one way, another in another; and you will do well in each case to bear in mind the particular mode of treatment which has proved of service, in order that you may at once resort to it, if you are called a second time to the same patient, under the same circumstances.

In one instance you will be able to pass a catgut bougie, and not a catheter; in another, you will be able to pass a catheter, and not a catgut bougie. One individual is relieved by opium, another by the warm bath. A gentleman of my acquaintance, who was subject to attacks of this description for a considerable time, almost always began to make water after a pint of warm water had been thrown up as a clyster. To show what various treatment is necessary, I have been in the habit of mentioning the following case. A gentleman, who had been long in hot climates, laboured under an old stricture of the urethra. He was able to pass a bougie for himself; and he did this at regular periods, and for a long time experienced little or no inconvenience from his disorder. One night, however, he was seized with retention of urine, and called me out of my bed in consequence. I introduced a gum catheter, which entered the bladder with perfect ease, and drew off the urine. He called me up another night, and another, and another still;

and one night he called me up twice. At last, it occurred to me that he always sent for me on the alternate nights; and, on inquiry, I found that the attack of retention regularly came on about twelve o'clock, and even though the catheter had entered the bladder, the spasm did not relax, so as to enable him to make water by his own efforts, until five or six in the morning. I determined then to treat the case as we do many other intermitting and periodical diseases; and I prescribed him the sulphate of quinine. The first night after he began to take it he had an attack of retention; but he had no attack afterwards.

Now let us suppose a case in which you have tried all the methods which I have described to no purpose. The bladder becomes more and more distended, the patient's sufferings go on from bad to worse. Are you to leave him to suffer and die? By no means. You may puncture the bladder itself; or you may make an opening into the urethra, behind the stricture, and thus prevent the catastrophe which would be otherwise inevitable.

Four different operations have been proposed for the purpose of drawing off the urine, when it cannot be voided by the natural passage. The bladder may be punctured above the pubes, or from the rectum, or from the perineum; or the urethra itself may be punctured between the stricture and the prostate.

It is not my intention at present to enter into a detailed history of each of these operations; but I shall nevertheless offer a few observations respecting them. You may prefer one operation to the other; but you will not be able in practice to resort to one exclusively. Your choice must be influenced by the particular circumstances of each individual case. If the patient be thin, and the bladder be much distended, you may puncture it above the pubes; but if the patient be corpulent, this operation will be difficult; and if the bladder be contracted, it will be impracticable. If the bladder be much distended and the prostate gland be of its natural size, you may puncture it from the rectum; but if the distension of the bladder be inconsiderable, or the prostate gland be enlarged, this operation will be at the same time difficult and

dangerous. The puncture of the bladder from the perineum is so serious and severe an operation, and attended with so great a chance of mischief, from the effusion of urine into the loose cellular texture, that no surgeon of the present day, as far as I know, ventures to recommend it. The puncture of the urethra from the perineum in thin persons, where the parts to be divided are not altered from their natural structure, is a sufficiently simple and unobjectionable operation. The staff introduced into the urethra shows the situation of the stricture. The membranous portion of the urethra is situated behind the stricture, and below the symphysis of the pubes; and the bulging of the urethra, as the urine is driven into it when the patient strains, points out the exact spot at which it may be opened. But it may be that the patient is a fat person, with a deep perineum; or that the parts in the vicinity of the stricture are in a state of gristly induration; or that the perineum has been at a former period the seat of abscesses and sinuses; or that such sinuses exist at the present moment: and any one of these circumstances will be sufficient to make the operation perplexing and difficult even to the best anatomist. On the whole, from what experience I have had on the subject, I am inclined to believe that the puncture of the bladder from the rectum is applicable to a greater number of cases than any other operation. In proper cases this operation is free from pain and danger, and it has the advantage of simplicity, being performed at once without difficulty. The trocar having been withdrawn, the canula should be allowed to remain in the rectum and bladder for one or two days. By the time that it is removed the sides of the wound will have become agglutinated, and it may perhaps continue as a fistulous communication between the bladder and rectum until the stricture is cured. At least this happened in one instance; and thus I was enabled to cure one of the most distressing cases of stricture which I ever had under my care. The patient was a middle-aged gentleman, who had laboured under the disease from his boyhood. The use of the bougie induced a secretion of ropy mucus in such quantity as to fill up the urethra, and to be in itself a material impediment to the

passage of the urine, and not unfrequently it occasioned a complete obstruction of the urethra, and a retention of urine. In one of these attacks of retention, I punctured the bladder from the rectum, and the wound, as I have mentioned, became fistulous. Now, whenever the stricture was more closed than usual, the bladder was relieved through the fistulous passage, and the urine came away by the rectum. The secretion of the ropy mucus ceased: there was no recurrence of the retention of urine. Nothing now interfered with the necessary operations on the urethra, and the dilatation of the stricture was easily accomplished.

It may be further observed respecting this operation of puncturing the bladder, that it is impossible to lay down any general rule as to the period beyond which it ought not to be delayed. You must exercise your own judgment, taking into consideration all the circumstances of the particular case before you. Sometimes there will be no reason for resorting to it until after the lapse of three or four days; and at other times it ought to be performed within thirty-six hours, or even sooner.

After all, however necessary it may be to the safety of the patient in some instances, it is an operation that is very rarely required. Surgeons who see a great number of cases of retention of urine, may, in the course of their lives, be called on to perform it in a *few* instances. Those, who perform it frequently, must often perform it unnecessarily; at least this is what I am bound to say, judging from my own experience.

Where the urethra has given way behind the stricture, and the urine has become effused into the cellular texture, very prompt and vigorous measures are necessary: delay is fatal. I remember the time when five out of six of the patients, in whom this mischief took place, perished; but now, from the more active treatment employed, under the hands of a well-informed surgeon the great majority recover.

I have already mentioned, that the effusion of the urine is followed by a relaxation of the stricture. You will, probably, now be able to introduce a catgut, or some other bougie (a catgut one is to

be preferred), through the stricture into the bladder. If you can do so, it is so much the better. Introduce the bougie; let the patient be held in the position in which you would place him for lithotomy; make an incision in the perineum; feel for the catgut bougie, make an incision on it, and, of course, you make an opening in the urethra. Through this opening, the catgut bougie serving you as a director, introduce a short gum catheter from the wound in the perineum into the bladder. You will generally find, although the effusion of urine has taken place, that there is still a large quantity of urine left in the bladder. Of course it is drawn off by the catheter, and the bladder is emptied. Allow the catheter, however, to remain in the wound and in the bladder. Then make extensive scarifications or incisions through the skin, wherever the urine has been effused underneath, and let these incisions extend to the sloughs of the cellular membrane. Apply a poultice: let the parts be fomented twice or three times daily. After one or two days you may remove the short gum catheter, which, in the meantime, has kept the bladder empty. Your treatment of the patient, in other respects, must depend on the existing symptoms, and on his general condition. At first, it is often right merely to give some saline medicine, with small doses of Dover's powder every six or eight hours: afterwards it will be proper to exhibit wine, ammonia, opium, and, perhaps, bark, or the sulphate of quinine: in other cases opium, cordials, and tonics may be required in the first instance. As soon as the sloughs begin to separate, remove them with a pair of forceps, and dress the sores according to circumstances.

In those cases of effusion of urine in which you are unable to pass an instrument into the bladder, you must be contented (as to the local treatment) with making a free incision in the perineum and extensive scarifications in the neighbourhood. Here the patient labours under a disadvantage, in consequence of the bladder remaining loaded with urine; but nevertheless, if the scarifications are made at an early period, he usually recovers.

LECTURE III.

ON THE CURE OF STRICTURE OF THE MALE URETHRA.

A STRICTURE at the orifice may be dilated by means of a common bougie, or a short metallic instrument; the size of the bougie being gradually increased, and the introduction being repeated daily, or on the alternate days, according to circumstances. The process of dilatation is, however, in many instances, attended with much inconvenience to the patient. In those cases especially in which the contraction began in early life, every introduction of the bougie causes considerable pain; at the same time that the disposition to contract is so great that the operation requires to be repeated almost daily. The consequence is, that the part is kept in a constant state of inflammation, and, between the disease and the remedy, the patient is in a state of constant distress. Under these circumstances another mode of treatment may be had recourse to, as in the case which I am about to mention.

A gentleman, 30 years of age, consulted me on account of a difficulty of making water, under which he had laboured since he was a child. The difficulty had increased by slow and almost imperceptible degrees, until at last, about fourteen months before he applied to me, he had a complete retention of urine. A surgeon, whom he then consulted, found the obstruction to be confined to the orifice, and that part of the urethra which is surrounded by the glans; and he relieved him without difficulty by means of a short and small bougie. This relief, however, was only temporary, and it was found necessary to have recourse to the use of the bougie almost daily; and even then the patient was not able to void his urine without considerable difficulty. An attempt

was therefore made to dilate the orifice further by means of larger bougies. But that treatment was productive of considerable inconvenience, and when the patient was under my care, the orifice of the urethra was tender and inflamed; the mucous membrane immediately within it seemed to be in a state of ulceration; and not only the insertion of the bougie but the contact of the urine always occasioned no trifling degree of pain.

It was evident that something more must, if possible, be done for the patient's relief; and, accordingly, I determined at once to divide the contracted part of the urethra. This was easily accomplished by means of a pair of knife-edged scissors, one blade with a blunt point being introduced into the urethra, and the division being made in the situation of the frænum. No hæmorrhage followed the operation. A piece of lint was kept between the cut surfaces to prevent their reunion, and in about ten days they were cicatrised, being covered by what had already assumed a good deal of the appearance of a mucous membrane.

Strictures in the anterior part of the urethra, but behind the orifice, require to be mechanically dilated, by the introduction of bougies or metallic instruments. At all events, I know of no better method of treatment; and sometimes the patient obtains relief on very easy terms, the dilatation being readily accomplished, and the use of a bougie once in three or four days being sufficient to prevent a recurrence of the contraction. At other times, however, the disposition to contract is so great, that it becomes necessary to introduce the bougie once or twice daily; and, indeed, I have known cases in which the patient was seldom able to expel his urine until the bougie had been employed.

The simple rules which have been just laid down are not sufficient for the treatment of strictures at the bulb of the urethra. The circumstance of these being situated where the curvature of the urethra begins, at a distance of six or seven inches from the external orifice, and their liability to spasm, distinguish them from strictures in the anterior part of the canal. The management of such cases requires greater skill, attention, and experience on the

part of the surgeon; but, at the same time, it must be acknowledged that it leads, on the whole, to more satisfactory results than that of strictures which take place elsewhere.

If you were to ask me, How then do you treat strictures at the bulb of the urethra? my answer would be, I have no particular method; sometimes I adopt one method, sometimes another, according to the peculiar circumstances of the case. I shall describe the different plans of treatment to which you may have recourse, at the same time endeavouring to point out the particular class of cases to which each of them is applicable.

I should premise, that the disease is not to be cured by medicine; though medicine may sometimes be used with advantage in aid of the local treatment. Thus, where the liability to spasm is increased by a too abundant secretion of lithic acid by the kidneys, whether it shows itself in the form of red sand, or of small calculi, or of lithate of ammonia, attention to the diet and mode of life, and the exhibition of purgatives and alkalies, and such other remedies as may tend to restore the urine to a healthy condition, will be of essential service, and will enable you to accomplish, by means of the bougie, what you would in vain have attempted to accomplish otherwise. In like manner, in cases of alkaline urine, a generous diet, the exhibition of tonics, and in certain cases that of the mineral or vegetable acids, will be productive of a similar advantage. In all cases attention should be paid to the state of the bowels, and the patient should be made to understand that a careful and regular mode of life in every respect is necessary to his recovery; and that violent bodily exercise, especially riding on horseback, is always to be avoided. In long-standing cases of unusual difficulty and complication, I have sometimes found it necessary to keep the patient confined to a sofa, or even to his bed, for some days before I began the peculiar treatment which his case required. Where, before the patient comes under your care, instruments have been much employed, without having penetrated through the stricture, it is always desirable that the urethra should be left for some time in a state of repose. At the

end of a month or six weeks, the false passages (if any existed) may have healed; the inflammation produced by previous operations may have subsided; and you will begin the treatment under more advantageous circumstances than if you had entered upon it in the first instance.

The methods which are chiefly useful in the case of stricture at the bulb of the urethra are:—1st, the dilatation of it by means of the common plaster bougie; 2nd, the dilatation of it by means of a metallic bougie, catheter, or sound; 3rd, the retention of the elastic gum catheter in the urethra and bladder; 4th, the application of the bougie armed with the nitrate of silver.

I. The common plaster bougie, if of a small size, should be of a conical shape; but if of a middle size, or of a full size, it should be cylindrical. Observe the stream of urine, and introduce a bougie of the same size, whatever it may be. If the bougie be very small, it may be used straight, otherwise it should be curved like a catheter, but in a less degree. Neither you nor your patient are to be disappointed because the bougie does not enter the stricture at the first trial. In many cases this will not happen until you have seen your patient three or four times; and in very difficult cases the delay may be still greater than this. When a bougie has once entered the stricture and bladder, allow it to remain there for a few minutes. In two or three days (not sooner) introduce either the same bougie, or one of the same size. Then withdraw it and introduce one of a size larger. Allow this also to remain for a few minutes, and after two or three days more repeat the operation. Thus, by degrees, you dilate the stricture until it is of the same diameter with the rest of the urethra. This method of curing strictures is applicable to a great number of cases; and wherever it will answer the purpose, I would advise you to resort to it in preference to other methods. The common bougie gives the patient little or no pain; it excites no irritation unless it be introduced clumsily or rudely; and it can do no harm by penetrating or tearing the membrane of the urethra.

II. The metallic instruments which I am in the habit of

employing are not those which are sold under the name of the flexible metallic bougies. These are liable to lose the shape which you have given them during their introduction, and, in fact, are at the same time too flexible and too inflexible for any useful purpose. Those which I have, if of a small or middle size, are made of solid silver, the larger ones of silver or steel, or steel plated, or of a composition similar to, but firmer than, that of the flexible metallic bougie. These sounds should be very slightly curved, and for ordinary cases not more than eight inches and a half or nine inches long, exclusive of the handle. You may use them as you would use the common bougie for the purpose of gradually dilating the stricture, beginning with one of a small size, and gradually proceeding to those which are larger. Sometimes you will find it best to introduce the sound without turning, that is, with the concavity towards the patient's abdomen; at other times you will pass it more readily by keeping the handle, in the first instance, towards the patient's left groin, turning the instrument afterwards as it approaches the stricture. In either case, if you wish to avoid making a false passage, take care that the point is kept sliding, as it were, against the upper part of the urethra. Press the instrument firmly, but gently, against the stricture, in the expectation that it will gradually become dilated, and allow the point to enter; then depress the handle, and pass into the bladder, provided that you can do so readily, and without the application of force; but not otherwise. Two or three days afterwards (and the interval ought to be never less than this, and sometimes it ought to be greater), introduce the sound which has been passed before, withdraw it, and introduce another of a size larger, and thus go on dilating the stricture until that part of the urethra has regained its natural diameter. If in the course of these proceedings you are in doubt whether the sound has reached the bladder or not, you may easily determine the point in question by introducing a catheter. You might, indeed, use the catheter from the beginning, but that the openings near the point, and its comparative lightness, render the introduction of it less easy than that of the solid instrument.

This method of treatment is applicable to a large proportion of the cases which you will meet with in practice: 1st, to those of old and indurated strictures, which the common bougie is incapable of dilating; 2nd, to those in which, in consequence of some improper management, a false passage has been formed, into which the point of a common bougie will easily penetrate, but which an inflexible instrument may be made to avoid; 3rd, to those in which, from long-continued disease, and without any previous mismanagement, the urethra has become distorted, and its surface irregular; and, 4th, to several recent cases in which the smooth polished metallic surface gives less pain to the urethra, and is less likely to induce spasm, than the softer but less smooth surface of a common bougie. The temper of the urethra varies as much as the temper of the mind. Where circumstances seem to be nearly the same, you will find one method of treatment to suit one case, and another to suit another case; and it will often happen that you cannot determine beforehand which method it will be best to adopt.

But the treatment which I have just described is not applicable to the most difficult class of cases which you will meet with in practice. In using a small metallic instrument, there is always a great risk that it may penetrate the membrane of the urethra, and make a false passage, instead of entering and dilating the stricture; and, therefore, in a case in which a stricture has been long neglected, and is reduced to a very narrow diameter, some other mode of proceeding is required. You may try a small plaster or catgut bougie first, and defer the use of the sound until the stricture is so far dilated as to justify the expectation that one of a moderate size may be passed. If this cannot be accomplished, you may resort to another method, which will rarely fail. In speaking of the use of the silver catheter where the patient labours under a total retention of urine, I said, 'Press the catheter firmly and gently against the stricture, keeping in your mind the anatomical position of the parts, and being careful to give the point a right direction. When the pressure has been thus carefully

continued for some time, the stricture will begin to relax, allowing the catheter to enter,' &c. &c. Now, in attempting the cure of old and inveterate cases of stricture, you will often find it convenient to act on the same principle, and you will find this mode of treatment to be very generally successful where the others have failed. The sound should be rather above than below the middle size. Of course the same rule in this case does not apply in every instance, but that which I generally find is most convenient to employ has only a moderate curvature. It is made of silver fixed in a flat wooden handle, being nine inches in length from the handle to the point; no part of it is more than one-fifth part of an inch in diameter, and at the point the diameter is reduced to one-sixth of an inch.

In using the sound you should pass it carefully as far as the stricture, and then press the point firmly and steadily against it, taking care that it is directed in the line of the urethra towards the bladder. The pressure is to be continued for five, ten, or fifteen minutes, or even longer, according to circumstances; and this process is to be repeated once in two or three days. If a false passage exists, it is probably on the lower part of the urethra towards the perineum; and it is especially in this situation that, by careless management, one may be easily made. To avoid this mischief, you must direct the point of the sound towards the upper part of the stricture next the pubes. The pressure should be as much as can be made without the urethra being lacerated, and without inducing any considerable degree of pain. In some instances the stricture has little or no sensibility, in others it is exquisitely tender; and in the latter cases the pressure should be very trifling at first, but it may be gradually increased as the tenderness subsides (as it will do) under its influence.

The result of this treatment is, that at each operation the anterior part of the stricture seems to become relaxed to a greater or less extent; and at last the instrument penetrates entirely through it and enters the bladder. The period at which this happens, of course, varies in different cases. The permanent

change of structure may be trifling, the stricture being chiefly spasmodic, and one or two applications of the sound may be sufficient. There may be much gristly induration, occupying a considerable portion of the urethra, and many applications may be required. A patient was under my care, in whom the stricture was surrounded by a mass of hard substance, which could be distinctly felt in the perineum, apparently an inch or an inch and a half in length. The stream of urine was of the smallest size, and varied so little that it was evident that there was little or no liability to spasms. For many years before I was consulted, no instrument had been made to enter the bladder; and the ordinary methods, after a long trial, failed in my hands, as they had done in those of others. At last I succeeded by the method which I have just described, but not until I had persevered in it for more than a year.

III. In treating a stricture of the urethra with the gum catheter, you are to introduce it, and allow it to remain day and night in the urethra and bladder. If the patient can bear it to be retained for a sufficient length of time, the stricture will become dilated not only to the size of the instrument employed, but to a size considerably larger. Perhaps you will be able to introduce the catheter without the wire or stilet. Do so, if possible. If not, you should employ one mounted in the way which I have already explained, on a strong unyielding iron stilet, having a flattened iron handle, like that of a common sound or staff. Being so mounted, it is more readily directed into the bladder than when mounted in the usual way, on a piece of thin flexible wire. When the gum catheter has entered the bladder, withdraw the stilet and leave the catheter, with a wooden peg in its orifice, which the patient is to take out whenever he has occasion to void his urine, it being at the same time secured by a suitable bandage. After three or four days you may withdraw the catheter for twelve hours; or if much suppuration be induced in the urethra, you may withdraw it for a longer period. Then introduce another catheter larger than the first; and thus you may, in the course of

ten days or a fortnight, dilate a very contracted urethra to its full diameter. This is a very certain and expeditious method of curing a stricture. But it cannot fail to occur to you that it is not adapted to the worst cases of the disease in the first instance. The stricture must be dilated to a certain extent before it can be had recourse to; but you may then by means of it often accomplish as much in two or three weeks, as you would accomplish in three months by the occasional introduction of a bougie.

This method is especially applicable:—

1st. Where time is of much value, and it is of great consequence to the patient to obtain a cure as soon as possible.

2nd. Where a stricture is gristly and cartilaginous, and therefore not readily dilated by ordinary methods.

3rd. Where, from the long continuance of the disease, the urethra has become irregular in shape, or where a false passage has been made by previous mismanagement. Under these circumstances, if you can succeed in introducing a gum catheter, and let it remain for a few days in the bladder, you will find your difficulties at an end; the irregularities will disappear, and the false passages will heal.

4th. There is still another class of cases in which this method of treatment is particularly useful. I allude to those in which a severe rigor follows each introduction of the bougie; this disposition to rigor is such, that it is sometimes impossible to proceed with the treatment in the ordinary way. Observe, in these cases, when the rigor takes place. It seldom follows the use of the bougie immediately. It almost always occurs soon after the patient has voided his urine, and seems to arise, not as the immediate effect of the operation, but in consequence of the urine flowing through the part which the bougie has dilated. Now, if instead of a bougie, you use a gum catheter, and allow it to remain, the urine flowing through the catheter, the contact of it with the urethra is prevented, and the rigor is prevented also. I may not be justified in saying that this plan will invariably succeed, but I do not remember that it failed in a single case among many in which I have resorted to it.

IV. It remains for us to consider the treatment of a stricture by the application of caustic. This mode of treatment was first proposed by Mr. Hunter, who recommended it in particular cases. The more general application of the caustic to strictures was introduced by Sir Everard Home, with whose work on the subject of this disease you ought to be well acquainted. The caustic employed is the nitrate of silver. Let a cylindrical piece of it be inserted neatly into the extremity of a bougie. The round end of the bougie should be cut off, and the caustic should be as large as the bougie will carry; and the bougie itself should be as large as the urethra will admit without being forcibly distended. First, pass a common bougie down to the stricture, and mark with your nail on the bougie the distance of the stricture from the external orifice of the urethra. Then measure off the same distance on the armed bougie; pass it down to the stricture, and keep it pressed against it with a firm hand, during the space of a quarter of a minute, and sometimes for a longer period. Let this be repeated, if necessary, every third or fourth day; for every second day, as some have recommended, is, according to my experience, much too often. I have advised that you should press it firmly against the stricture, as otherwise the caustic is applied to the urethra anterior to the stricture, and not to the stricture itself. The first effect of the caustic is to cause the stricture to become dilated to a certain extent, probably by relieving whatever disposition there is in it to spasm. It is a strong stimulus applied to a part which is morbidly irritable, and the morbid irritability becomes exhausted. The benefit which the patient derives immediately from the application of the caustic is sometimes very remarkable. He may apply to you, making water in a stream like a thread, or only in drops; you apply the caustic, and in a few minutes afterwards he has a desire to discharge the contents of his bladder, and he finds that the urine flows in a very considerable stream. After this, any further benefit to be produced by the caustic must be the result of the destruction of the stricture by the repeated formation of sloughs. But this is a tedious and difficult process, especially

in cases of old cartilaginous stricture. In fact, there are very few such cases in which a cure can be effected by the caustic alone, however long you may persevere in its use; and, whenever the caustic is frequently employed, you are in danger of creating a false passage in consequence of the dissolved caustic flowing to the lower part of the urethra, and destroying the parts unequally.

The cases to which this method of treatment is applicable are, 1st, Those of spasmodic stricture, where two or three applications of the caustic may be sufficient to relieve all the urgent symptoms. 2nd. Some cases of old permanent stricture, in which there still is a considerable disposition to spasm. In these last cases, a few applications of the caustic will probably relieve the contraction as far as it is spasmodic, and thus enable you to proceed more advantageously with the use of the bougie or metallic sound. 3rd. The caustic may be used very properly in some cases of stricture which are endowed with peculiar irritability, in which every application of the common bougie induces severe pain, or brings on spasm, preventing it from entering the stricture. Two or three applications of the caustic may be sufficient to deprive the stricture of that unnatural sensibility which otherwise would have foiled your efforts to effect a cure.

Notwithstanding what I have now stated, I very rarely use the armed bougie in my own practice, and I never resort to it in the first instance. My reasons for preferring the other methods of treatment in ordinary cases are these: 1st. Although the caustic often relieves spasms, it also very often induces it. It is true that in many instances it enables a patient to make water with more facility; but in many instances, also, it brings on a retention of urine. 2nd. Hæmorrhage is a more frequent consequence of the use of the caustic than of the common bougie, and it sometimes takes place to a very great and to an almost dangerous extent. 3rd. Where there is a disposition to rigors, the application of the caustic is almost certain to produce them; and frequently the application of the caustic induces rigors where there had been no manifest disposition to them previously. 4th. Unless used with

caution, the application of caustic may induce inflammation of the parts situated behind the stricture, terminating in the formation of abscess. I have known some cases of abscesses formed under these circumstances, which, from their peculiar situation, have proved more troublesome and more difficult to manage than the original disease. In one case, which came under my observation many years ago, and in which, from the account given me, I was led to believe that a surgeon had been too liberal in his application of caustic to a stricture, a succession of abscesses took place, extending in various directions, even to the nates, and attended with great disturbance of the constitution. The patient went into the country, where, as I have been informed, he ultimately sank under the combined effects of the stricture and abscesses.

These are the principal evils which follow the use of the caustic: but there are other arguments against it in particular cases. If the bougie has been improperly used, and a false passage has been produced, or if there be the beginning of a false passage, the dissolved caustic will penetrate into this false passage, and aggravate the mischief instead of destroying the stricture. In cases of old stricture, where there is much alteration in the structure of the parts, the caustic, as I have already observed, is absolutely inadequate to the cure; and in many other cases, although the caustic may effect a cure at last, it does so by a very tedious process: and a cure would be effected in a much shorter space of time by the introduction of the metallic sound, or the retention of the gum catheter.

There are still some other methods of treating stricture of the urethra, but what I have to say concerning them may be comprised in a few words. Dr. Arnott has invented what he calls a dilator, made of a tube of varnished silk, which is to be introduced into the stricture, and then dilated by impelling air into it with a syringe. The contrivance is ingenious; and I should think it very likely to be useful, where you wish to dilate the female urethra for the purpose of extracting a calculus. It may be useful also, in dilating the orifice of an abscess or sinus, being used

instead of a sponge tent. But it does not appear to me that either this, or a steel dilator, which I remember some one to have invented formerly, is likely to render us much assistance in the cure of a stricture. Such a dilator must be of a certain size. It cannot be supposed to be less than a middle-sized bougie. Now, if you can manage to introduce a bougie or sound of a middle size into a stricture, the farther dilatation of it is easy enough, the cure may be said to be all but accomplished, and no other dilator can be required than the bougie itself. On the other hand, if the stricture be much contracted, the introduction of the dilator will be impossible. It is stated by Dr. Arnott, that the method proposed by him has this advantage, that it enables you to carry the process of dilatation farther than it can be carried by a bougie or sound, and that such farther dilatation removes the disposition in the urethra to contract, and thus produces a permanent cure of the stricture. I am by no means satisfied as to the correctness of the first of these assertions; and as to the second, it is entirely contrary to my own experience of the effects of very large bougies. I have generally observed, that the dilatation of a stricture beyond the natural size of the canal is followed by pain and inflammation, and an aggravation instead of a diminution of the complaint.

Mr. Stafford has invented an ingenious machine, which is intended to divide a stricture by means of a cutting instrument. If any cases occur in which this method may be useful, they are undoubtedly very few in number; and great caution must be required to avoid making false passages, which might be followed by effusion of urine and purulent deposits. There is, however, a modification of this practice which is free from these dangers, and which may be resorted to in certain cases with great advantage, as I shall explain presently.

It has been proposed, in cases of very old stricture, to make an incision in the perineum, so as to expose the whole of the contracted part of the urethra, and to divide the stricture with a knife, introducing a gum catheter afterwards through the urethra into the bladder, and allowing the wound to heal over it. I have

performed this operation myself in one instance, and with success; and I have heard of it being performed several times by others. In the greater number of cases (according to the reports which I have received) it has been performed with difficulty, and in some instances the patient has been sent to bed without it having been completed. Even under the most favourable circumstances it cannot be otherwise than doubtful whether the stricture be properly divided, that is, whether the incision has passed through the narrow canal in the centre, or through the solid substance on one side of it. I suppose that no surgeon would recommend such an operation except as a last resort, where no instrument could be made to pass through the stricture by other means. But such cases of impenetrable stricture are of very unfrequent occurrence: and where they do occur, I am much mistaken if the modification of Mr. Stafford's operation, to which I have already alluded, will not effect a much easier and safer method of cure. In the following case (the only one in which I have had recourse to it) it succeeded perfectly:—

A man, 40 years of age, was admitted into St. George's Hospital, in the year 1835, labouring under a stricture, near the bulb of the urethra, complicated with a fistulous opening in the perineum. When he voided his urine, a very small quantity came away by the urethra, the greater part being discharged by the perineum. The disease had existed for more than twenty years, and the abscess in which the fistula had originated had followed an injury received while riding on horseback thirteen years ago. For many years no instrument had been passed through the stricture. At last he became a patient under the late Mr. Earle, in St. Bartholomew's Hospital, where he remained under treatment for five months, but with no more success than formerly.

Finding after repeated trials that no instrument could be made to penetrate through the stricture, with the concurrence of my colleagues I performed the following operation:—

The patient having been placed in the same position as in lithotomy, a full-sized plaster bougie was introduced, and held by an assistant

with its extremity resting against the stricture. I then made an incision in the perineum, dilating the fistulous sinus, and laying open the membranous part of the urethra as far forward as the stricture, the exact situation of which was marked by the bougie. The bougie was then withdrawn, and an instrument was introduced in its place, consisting of a straight silver tube, closed at its extremity, except a narrow slit, through which a small lancet could be made to project by means of a simple contrivance which I shall explain presently. The round extremity of the tube being pressed against the anterior part of the stricture, I applied the fore-finger of the left hand, introduced through the wound in the perineum and urethra, to its posterior surface. The pressure of the instrument being distinctly communicated to the finger through the substance of the stricture, the lancet was protruded, and the stricture was divided. A silver catheter was then easily introduced through the urethra and the divided stricture, into the bladder, and allowed to remain there. The urine of course flowed through the catheter. At the end of two days the silver catheter was removed, and replaced by one of elastic gum. The wound in the perineum gradually healed, and the patient ultimately recovered, making water in a full stream, and being able to introduce a sound of a full size into the bladder, so as to prevent a recurrence of the contraction.

The instrument used on this occasion was a silver tube ten inches in length, exclusive of the handle, and rather more than one quarter of an inch in diameter. It contained a wire or stilet, one end of which terminated in a thin blade or lancet, while the other end, having a button attached to it, passed through the handle of the instrument. By pressure on the button, the lancet could be protruded to the length of half an inch, returning to its place within the silver tube, when the pressure was withdrawn, by the action of a spiral spring. In using it, one cutting edge of the lancet was directed towards the pubes, the other towards the perineum. The advantages of dividing the stricture by this method, as compared with other methods of operating, are, 1st, that the

free opening made in the perineum prevents all danger from infiltration of urine; 2dly, that the fore-finger of one hand, being applied to the posterior surface of the stricture serves as a guide for the lancet, and enables you, with the exercise of a little skill and caution, to make an exact division of the stricture.

In many cases of stricture, especially where the disease has existed for several years, you find that, although a bougie may be passed through the contracted part of the urethra, it will not enter the bladder. You may possibly succeed in the introduction of a metallic sound or catheter when you have failed to introduce a bougie; but not unfrequently the obstruction which has prevented you from passing the bougie will prevent you from passing the metallic instrument also. The obstruction in these cases arises from the irregularity of the surface of the urethra, where it is surrounded by the prostate gland, the immediate causes of which I have already described; and sometimes from enlargement of the prostate gland itself. If you use violence, or employ any but the gentlest treatment, you lacerate the membrane of the urethra and the substance of the prostate. You make a false passage leading into the space between the bladder and the rectum, which may prove a source of constant trouble and perplexity afterwards. When you meet with the difficulty which I have mentioned, do not be over-anxious immediately to overcome it. It is not the original disease, but the effect of the stricture. Remove the cause, and the effect will cease, not indeed at once, but by degrees. The stricture having been dilated, the urine will flow in a full stream, and the pressure of it on the parts behind being removed, they will regain their healthy condition; so that at last the catheter, or even the common bougie, will enter the bladder readily.

I say that you are not, under the circumstances which I have described, to use violence. But I cannot too strongly impress it on your minds, that, in the treatment of stricture, you ought not to use violence under any circumstances. Your success in the cure of this disease will depend very much on your attending to this important rule. Whether you use a bougie, or a sound, or a

catheter, let the instrument be held lightly, and, as it were, loosely, in your hand; it will then, in some measure, find its own way in that direction in which there is the least resistance; whereas, if you grasp it with force, the point can pass only where you direct it, and it is just as likely that it will take a wrong course as a right one. A stricture will invariably resent rough usage: it will yield to patience and gentle treatment.

In a few cases of incipient stricture, and in some of those in which a stricture is merely spasmodic, after a bougie has been used for a certain length of time the use of it may be dispensed with, and there will be no recurrence of the disease. But these cases are rare exceptions to the general rule, which is, that there is danger of a relapse, and that a patient, who is desirous of continuing well, must submit to the occasional use of the bougie ever afterwards. I generally instruct the patient in the introduction of it for himself. At first he may introduce it once in three or four days. He may afterwards use it at longer intervals, and he must take some pains to determine what those intervals should be. One person will find it necessary never to omit the use of the bougie for a longer period than a week, and another will not have occasion to resort to it oftener than once in a month or six weeks.

The management of a case of stricture in which the patient is liable to attacks like those of intermittent fever, is often very perplexing. Occasionally, every introduction of a bougie is followed by a rigor which is not only distressing to the patient at the time, but leaves him in a state of debility from which he may not recover for several days. And sometimes the rigor, as I have already explained, is only the precursor of a still worse train of symptoms, assuming the character of simple continued fever, of rheumatic fever, or even of mania. It is impossible to continue the use of the bougie under these circumstances. If you would cure the stricture, you must prevent the rigors. I have already mentioned one way of attaining this object, namely, by leaving the gum catheter in the bladder. You may also, in many instances where you expect the occurrence of a rigor, anticipate the attack

by giving your patient a dose of opium, either by the mouth or in the form of clyster, or a tumbler of hot brandy and water (which is, perhaps, preferable to the opiate) immediately after you have introduced the bougie. But you are not to be contented with meeting the present difficulty. You should look to the future, and endeavour to correct that state of the system on which the disposition to rigors depends. For example, I was sent for to see a gentleman who had long suffered from a stricture of the urethra, and who was at the time labouring under a severe attack of retention of urine. I drew off his urine with a small elastic gum catheter, which was passed with the greatest facility into the bladder. In the course of two or three hours he experienced a desire to void his urine. It flowed readily in a stream, but immediately afterwards he was seized with a violent rigor. He remained feverish for a day or two, and then recovered. After a few days had elapsed, I began the dilatation of the stricture with a common bougie. The bougie was introduced without any difficulty, but it was followed by a rigor. The next time that the bougie was employed, there was a third attack of the same kind; and on the bougie being again resorted to, another rigor followed. I now omitted for a time the use of the bougie, and prescribed a solution of two grains of sulphate of quinine to be taken every six hours. Under this treatment the patient's general health manifestly improved; and when, at the end of a week or ten days, we had recourse again to the bougie, there was no recurrence of the rigors. I have treated other cases in which there was a great liability to the occurrence of rigors in the same manner with a similar favourable result.

LECTURE IV.

TREATMENT OF STRICTURE OF THE MALE URETHRA—*continued.* URINARY ABSCESSES AND FISTULÆ.

You will meet with no cases in your practice of greater importance than those of urinary abscess connected with stricture of the urethra; nor are there any in which the different results obtained from good and bad surgery are more conspicuous than in these. If an abscess, with distinct fluctuation of matter, presents itself in the perineum, no one would hesitate to make an opening for the purpose of enabling the matter to escape. But it will often happen that there are urgent constitutional symptoms, and that the patient is in a state of the greatest danger, while the abscess is still confined behind the deep-seated fascia, the only external manifestation of it being a slight degree of fulness, and a deep-seated hardness of the perineum. These, however, will be your sufficient guides. Bearing in mind the anatomical position of the parts, introduce a sharp-pointed double-edged scalpel, so as to penetrate the fascia. Watch for the first drop of matter which escapes, and then dilate the opening which you have made downwards and outwards, that is, in the same direction as the incision in lithotomy. There is here no time for hesitation and delay. Many lives have been preserved, under these circumstances, by the prompt interference of the surgeon, which would have been lost otherwise. An urinary abscess cannot be opened at a too early period; and the opening should be as free as it can be made with prudence. This last observation is especially applicable to those cases in which the abscess shows itself near the lower part of the penis where it is covered by the scrotum. If in such cases there be merely a small puncture, there is danger of some of the contents

of the abscess being infiltrated into the loose cellular texture of the scrotum, producing an œdematous swelling first, and a succession of secondary abscesses in the scrotum afterwards.

I know that some surgeons formerly have supposed that a fistula connected with the urethra required to be laid open like a fistula connected with the rectum. But I suppose that few are liable to fall into such an error in the present day. The only cases of this description in which the use of a bistoury or lancet may be required, are those in which there is a lodgment of matter in some part of the perineum, and in which a more free external opening is necessary for its escape.

The treatment of a fistula in perineo is, indeed, for the most part, as simple as possible. It is kept open by the urine flowing through it; and as soon as the urine finds a more ready outlet by the natural channel, the sides contract, and the sinus closes of itself. While the urethra remains contracted, no art can heal the fistula; nor ought you to wish to heal it, if it were possible for you to do so. But let the stricture be dilated, and in the great majority of cases the healing of the fistula will be completed, even before the dilatation has gone so far as to restore the urethra to its original diameter.

Sometimes, however, the healing of the fistula proceeds more slowly; and this especially happens where the opening is of a large size, in consequence of there having been some loss of substance from sloughing of the cellular membrane at the time of the abscess being formed. Even in these cases you will seldom find any other treatment necessary than that of dilating the stricture to the full diameter of the urethra, and then keeping it dilated by the daily introduction of a sound or catheter. The opening in the perineum may not close for a month, nor for six months, nor even for a year; but it will close at last. I formerly have advised the patient never to void his urine without the aid of the catheter; but I am now inclined to believe that the irritation thus kept up tends, on the whole, to delay rather than to expedite the cure. At other times I have kept the patient in bed

for some weeks, with an elastic gum catheter constantly in the urethra and bladder; but I cannot say that, with my present experience, I have much more faith in this mode of treatment than in that which I have just mentioned. After a few days, the urine generally begins to flow by the side of the catheter, which does not therefore answer the purpose for which it was introduced, of preventing its escape by the sinus. Then in many cases the catheter has the effect of a seton, causing an abundant suppuration of the urethra; and the purulent discharge, finding its way into the sinus, prevents it from closing as much as it would be prevented by the contact of the urine.

In proportion as I have acquired greater experience of these cases my confidence has increased in the simple mode of treatment which I have just mentioned: namely, the daily introduction of a metallic instrument into the bladder, the patient, at the same time, leading a quiet and regular life. If, however, it should really fail, you may have recourse to the following method of treatment in addition:—arm the blunt end of a probe with the nitrate of silver (which is to be done by dipping it into the melted caustic). Stimulate the bottom of the sinus once in four or five days by introducing the probe thus armed into it; at the same time that you retard the healing of the external orifice by lightly touching it, once in a week or fortnight, with the caustic potash. The reason for applying the caustic potash is as follows:—The external opening is more inclined to heal than the opening into the urethra. If you stimulate the whole surface of the fistula with the nitrate of silver, the superficial parts may heal prematurely; the necessary consequence of which will be another abscess and another discharge of matter. By applying the caustic potash to the external opening, you prevent this from healing, while the nitrate of silver promotes the contraction and cicatrisation of the more deep-seated part of the fistula.

An abscess or fistula, which has no opening except into the urethra, is to be treated in the same manner as the same kind of abscess in connection with the rectum. Watch for the opportunity

when matter is collected in it, and then establish an external opening by dividing the superjacent parts, with a lancet, so as to convert it into a fistula of the ordinary kind. There are some of these cases, however, the treatment of which requires a more particular explanation. A patient may apply to you who perhaps has had gonorrhœa formerly, followed by a slight obstruction of the urethra, complaining at the same time of a discharge from the urethra, which he calls an obstinate gleet. You examine the perineum, and you find in it a small tumour, not larger than a horse-bean or filbert. It is at some distance from the surface, and the patient says that it has been coexistent with the gleet, and that it is sometimes inflamed and tender. Now this little tumour indicates the existence of a blind fistula. There is a small orifice in the urethra, and a narrow channel leading from it into the centre of the tumour; and every time that the urine flows, a very minute quantity finds its way into this channel, escaping from it immediately afterwards by regurgitation into the urethra. In consequence of the smallness of the cavity, and the quantity of solid matter deposited on its outside, the fluctuation of fluid in it is not perceptible. I have known this state of things to continue, producing more or less occasional inconvenience, for some years. The first thing necessary to the cure is to make an opening in the perineum leading into the cavity in the centre of the tumour. But this may not be very easily accomplished, on account of the smallness of the cavity. You should introduce the lancet somewhat obliquely, so as to divide the tumour as nearly as possible through its centre. Then introduce some lint, so as to prevent the wound from uniting by the first intention. After three or four days you may remove the lint, and then you will ascertain whether you have done what was required, by observing whether, when the patient voids his urine, any portion of it flows through the opening which you have made. If this be the case, nothing further is required than that the stricture should be dilated in the usual way. If, however, no urine flows through the opening, you may proceed thus:—Introduce a probe, the end of which has been

armed with caustic potash (by being dipped in the caustic in a melted state) through the wound into the centre of the tumour, so as to make a considerable slough. A portion of the tumour being thus destroyed, the probability is that, when the slough has separated, it will be found that the central cavity is exposed, and that you have accomplished the object which you had in view.

We occasionally meet with cases in which there is a fistulous opening into the urethra in some part of the space between the scrotum and the external orifice. Where the opening is of a small size, it may usually be made to contract and heal by touching the margin of it occasionally with the nitric acid or nitrate of silver. Where, however, there has been a considerable loss of substance, either from ulceration or sloughing, it is impossible to close the opening without borrowing a portion of skin from the neighbouring parts. Sir Astley Cooper and Mr. Earle have published an account of some cases in which this operation was attended with success. Since then, the late M. Dieffenbach has performed it in a great many instances. You will find an account of his practice in the 'Dublin Journal of Medical Science,' to which I may refer you for further information on the subject.

Obstructions of the Urethra arising from Mechanical Injury. Treatment.

The obstructions of the urethra which are occasionally met with as the result of mechanical injury necessarily produce many symptoms corresponding to those which occur in ordinary cases of stricture. They differ from them, however, in some essential circumstances, and therefore require a separate consideration.

These obstructions may take place in any part of the canal, and may be produced in various ways. A foolish boy contrived to slip his penis into a small metallic ring. The swelling of the glans made its removal difficult, and, when this was at last accomplished, it had caused ulceration of the skin and corpus spongiosum, extending into the urethra. As the ulcer healed, the urethra became contracted; and when the patient was admitted into the

hospital some time afterwards, there was a small fistulous orifice in the middle of a hard cicatrix, through which the greater part of the urine was discharged, while a common probe was with difficulty passed from the external orifice through that portion of the urethra which was included in the cicatrix.

But the more frequent seat of the obstruction is that part of the urethra which is immediately below the pubes, where the mucous membrane is especially liable to suffer from a blow, compressing it against the hard surface of the bone. In some cases these obstructions are formed where there is no evident injury of the integuments or the other superficial parts of the perineum. For example, a man, 22 years of age, while riding a restive horse, was suddenly thrown forwards, so that his perineum received a severe blow from the pummel of the saddle. The accident caused at the time a severe pain, attended with a discharge of blood from the urethra. The bleeding continued during the night, but had ceased on the following morning. He then experienced a smarting pain in making water, which however subsided in a few days. During the following month he suffered no inconvenience, but he now observed that his stream of urine was diminished in size, and that it was sometimes divided into two streams. The diminution of the stream continued, with a good deal of pain as the urine flowed. At last there was a complete retention of urine, which however subsided spontaneously in the course of a few hours. Seven months after the accident, when he was admitted into the hospital, the urine flowed in a stream not larger than a small wire. The catheter met with an obstruction behind the bulb of the urethra, and one of a very small size was with great difficulty introduced into the bladder, passing over what appeared to be a hard gristly and irregular surface. The dilatation of the contraction was not accomplished without a great deal of both local and constitutional disturbance, and it was not until after the lapse of five months that the patient was able to leave the hospital. At this time a catheter of a middle size could be introduced into the bladder, and the urine flowed in a stream, much smaller than the natural size,

but sufficiently large to enable the bladder to be emptied without difficulty.

In other cases a deep wound of the perineum may extend into the urethra. If the urethra be only partially divided, I conclude that no more mischief will ensue than after the operation of lithotomy; but if the division be complete, it is difficult to conceive that, in the progress of the cicatrisation, a contraction of the urethra should not ensue. I met with an example of this in a child, who had received a wound of the perineum some time before, (if I recollect rightly) from a broken glass bottle. There was a hard cicatrix immediately below the pubes and behind the scrotum, and a fistulous sinus through which the urine flowed, while scarcely any was voided by the natural passage.

But there are cases of more frequent occurrence, in which a blow on the perineum has lacerated the urethra, contused the parts between it and the skin, caused an effusion of blood into the perineum and scrotum, some portion of urine becoming infiltrated into the cellular membrane afterwards; the result of the whole being the formation of an abscess, and the destruction of the injured parts by sloughing to a greater or less extent. Here, as the sore heals, a hard gristly cicatrix is generated, adhering to the pubes, with an orifice in the perineum, through which the whole or the greater part of the urine is discharged.

The condition of a patient under the circumstances which have been described is much worse than that of one who labours under a perineal fistula connected with an ordinary stricture of the urethra. The difficulty of voiding the urine is more constant; it is liable to be increased, so as to become a complete retention, from attacks, not of spasm, but of inflammation, attended at the time with much pain in the perineum, and followed by a fresh accumulation of matter beneath the cicatrix. In addition to all this, the treatment of these cases is not less troublesome to the surgeon than it is distressing to the patient, and for the most part does not lead to the same satisfactory results as the treatment of cases of ordinary stricture.

In all cases in which there is reason to believe that the urethra has been divided or lacerated in consequence of an injury inflicted on the perineum, it is the duty of the surgeon, not only to look at the great and immediate danger, but to guard against future ill-consequences; and much may be done in the first instance towards preventing mischief from which it would be very difficult to relieve the patient afterwards. If there be a penetrating wound, in which the urethra is probably implicated, an elastic gum catheter should be introduced with the least possible delay, and allowed to remain in the urethra and bladder until the healing of the wound is far advanced, or, at all events, until it has been ascertained that the urethra has not suffered; the catheter being however occasionally removed for a limited time, if it seems to act as a cause of irritation.

In cases of contusion of the perineum, without an external wound, when an effusion of blood in the perineum and scrotum or a discharge of blood from the urethra, or any other circumstances, lead to the suspicion that the urethra has been injured, the same treatment should be had recourse to. The gum catheter should be introduced as soon as possible, and allowed to remain for at least some days after the occurrence of the accident. The extravasation of blood does not in itself justify the making an incision in the perineum; and indeed, according to my experience, there can be no worse practice than that of making an incision in a case of simple ecchymosis, either under those or under any other circumstances. But, as where such extravasation exists, there is always reason to apprehend that there may be further mischief, the progress of the case should be carefully watched, and on the first appearance of any symptoms indicating that urine has escaped into the cellular membrane, or that abscess is forming, a staff should be introduced into the urethra instead of the gum catheter, and a free incision should be made from the perineum into it, the gum catheter being replaced afterwards.

But it may be that these measures of precaution have not been adopted at the proper period, that you are not consulted until

after the lapse of a considerable time, when the laceration of the urethra is already healed, leaving the canal contracted in the situation of the cicatrix. Here you may perhaps succeed in gradually dilating the urethra, as where there is an ordinary stricture. But, in a case which I have already mentioned, I have stated that 'this was not accomplished without a great deal of local and constitutional disturbance;' and so it has been in all the cases of this kind which have fallen under my observation. Nor will the occurrence of such difficulties be a matter of surprise to anyone who bears in mind that here the object is to dilate, not a genuine stricture, but a cicatrix, of the urethra, and who has observed how the cicatrix of an old sore leg inflames and cracks when the subjacent muscles begin to increase in bulk from exercise, or how the endeavour to extend forcibly the contraction after an extensive burn, produces the same result. It may be that these difficulties are insuperable under the method of treatment by simple dilatation; and under these circumstances, a small staff having been introduced into the bladder, the cicatrix of the urethra should be divided by an incision from the perineum, a gum catheter being introduced afterwards and allowed to remain until the wound is healed over it. But even then much remains to be accomplished. The cicatrix has still a greater disposition to contract than an ordinary stricture; the bougie, or catheter must be had recourse to almost daily, and the patient must be contented if he can persevere in the use of instruments of a moderate diameter, as the urethra will invariably resent the attempt to keep it dilated by those of large dimensions.

Under the treatment which has been just described, you will rarely fail to improve the condition of the patient in those cases in which the injury of the urethra has been of limited extent. But it is otherwise with respect to those other cases in which there has been an actual loss of substance of some portion of the canal from ulceration or sloughing. Here, either the patient must be left to the discomfort and misery of voiding the whole of his urine by the perineum for the remainder of his days, or he must submit to

an operation, to perform which, in a satisfactory manner, requires the utmost exertion of skill on the part of the surgeon, and of which, even then, nothing better can be said than that it is the only thing which, under his peculiar circumstances, affords the patient a reasonable prospect of relief. The object of the operation is to make an artificial communication between the anterior and posterior portions of the urethra (so as to supply the place of that part of the canal which is deficient) through which the urine may flow, instead of escaping by the fistulous opening in the perineum.

I cannot explain what I have to say on this subject better than by briefly relating the following cases.

A young man, in making a leap on horseback, received a violent blow on the perineum from the pummel of the saddle. The immediate consequence of the injury was hæmorrhage from the urethra, and this was followed by extravasation of urine, and sloughing of the perineum to a considerable extent. A catheter was at first introduced into the bladder, but it was afterwards removed. The sloughs having separated, the sore in the perineum gradually closed, a small fistulous opening only being left immediately behind the scrotum, through which the whole of the urine was discharged. He was in this state seven months after the occurrence of the accident, when he arrived in London, and Mr. Baker of Bulstrode Street advised him to have my opinion on his case.

On introducing an instrument into the urethra, I found an obstruction of the canal immediately below the pubes. Several ineffectual attempts having been made to penetrate the obstruction in the usual manner by bougies and sounds of various sizes, I had recourse to the following operation:—The patient having been placed in the same position as in lithotomy, a staff was introduced into the urethra, and held by Mr. Hilles (who, with Mr. Baker, assisted me in the operation), with the extremity of it resting against the obstruction. I then made an incision in the perineum, extending backwards from the part in which the staff was to be felt, in the direction towards the prostate gland. It was

now evident that not less than three-quarters of an inch of the urethra was deficient below the pubes; the place of it being occupied by a rigid cicatrix. This having been divided longitudinally by the point of the scalpel, I was enabled, though not without some difficulty, to pass the staff from the part at which the extremity of it rested, into the sound portion of the urethra towards the bladder, and then into the bladder itself. The staff was then withdrawn, and an elastic gum catheter having been substituted for it, the latter was allowed to remain in the urethra and bladder. On the ninth day after the operation, there being some degree of irritation at the neck of the bladder, the catheter was removed, being reintroduced, however, after two days more. From this time it was removed at intervals, which were sometimes longer, sometimes shorter, according to circumstances. The wound in the perineum gradually healed, and in less than ten weeks from the time of the operation, it was reduced to the diameter of a small pea. The patient was now able to introduce a silver catheter of the size of his urethra into the bladder without difficulty, and he repeated this operation so as to draw off his urine three or four times daily. When he voided his urine without the catheter, by placing the point of his finger on the opening in the perineum, he was enabled to discharge the whole in a sufficient stream by the urethra. The opening healed in the course of the following year, and Mr. Baker informs me that he saw the patient quite well (but still continuing the occasional use of the catheter) five years after the operation; but that he has since died, his death having been occasioned by some other disease.

In the other case, to which I have alluded, the patient was a gentleman 19 years of age, who had received an injury of the perineum in leaping over a gate. When I was consulted, a year afterwards, he voided his urine by an opening in the perineum. Other methods of relieving him having been fairly tried, and having failed, I made an incision in the perineum, and there discovered that about three-quarters of an inch of the urethra immediately below the pubes was deficient. To supply the

deficiency, I made an artificial passage connecting the anterior and posterior portions of the urethra together, by perforating the cicatrix by means of the instrument having the concealed lancet, which I have already described, leaving an elastic gum catheter in the urethra and bladder afterwards. At the end of three months the urine flowed in a full stream by the urethra, no more than a few drops escaping by a small opening which still remained in the perineum. A common plaster bougie could be easily introduced by the urethra into the bladder. The patient learned to perform this operation for himself, and I saw him nearly a year afterwards, having the opening in the perineum closed, and suffering no inconvenience except the trouble of passing the bougie. I have not heard of him since.

LECTURE V.

ON SOME OTHER DISEASES OF THE MALE URETHRA.

THERE are some other diseases of the male urethra which, in a greater or less degree, obstruct the flow of urine, but which are to be distinguished from the disease to which our attention has been hitherto directed.

In cases of ulcer of the glans including the whole circumference of the orifice of the urethra, as the ulcer heals, the orifice becomes contracted, so that when the healing process is completed the stream of urine is much reduced in size. But this is not all. The contraction, if left to itself, goes on increasing, until at last there is a complete retention of urine, and it is very probable that you are not called in until this last stage of the disease.

The management of the case, in some instances, is rendered more complicated by the circumstance of the præpuce having contracted partial adhesions to the surface of the glans, at the same time that there is a complete phimosis. Where this complication exists, you must begin with dividing or slitting up the præpuce. You then find the exposed surface of the glans, in all probability, presenting the appearance of an irregular cicatrix, in which you may discover, but probably not without a minute inspection, the contracted orifice of the urethra. Into this orifice introduce a small silver probe, such as is made to be inserted into the punctum lachrymale of the eyelid. Having withdrawn this, introduce another probe of a somewhat larger size; then one a little larger still; and afterwards insert a common silver director, passing it as far as one or two inches into the urethra. This will enable the patient to make water, the urine flowing along the

groove of the director. After the bladder is emptied, introduce the point of a straight bistoury along the groove of the director, and divide the contracted orifice of the urethra. Let the patient retain a gum catheter in the urethra and bladder until the incision is nearly healed. He will then make water without the smallest difficulty or impediment: but the cicatrix has the same disposition to contract as before; and, in order to prevent the contraction again taking place, a bougie about two inches long should be introduced into the urethra every morning, and allowed to remain there for five or ten minutes.

The urethra is, as you well know, surrounded by mucous follicles, which secrete a mucus by which the canal is lubricated. In some cases, one of these follicles becomes converted into a small indurated tumour, varying, in different cases, from the size of a hemp-seed to that of a horse-bean. Such a tumour is to be felt, imbedded, as it were, in the corpus spongiosum. The usual situation of it is about two or three inches from the external orifice, but it is sometimes perceptible close to the frænum, and at other times within the scrotum. The disease undoubtedly originates in inflammation; but, being once established, the tumour may remain unaltered after all symptoms of active inflammation have subsided. If it be very small, it gives the patient little or no inconvenience; but otherwise, it torments him by producing chordee, and by keeping up a constant gleety discharge from the urethra. In many cases, in which what is called a gleet continues unabated for a great length of time, this depends on the irritation kept up in the way which I have just described. For the most part, it is better to allow the disease to take its own course. The tumour may disappear in the course of a few weeks or months. If it should not do so, you may then endeavour to reduce it by the external application of the unguentum hydrargyri with camphor; or by keeping the patient in bed, with a gum catheter in the urethra and bladder. This plan may be pursued for a few days each time, and repeated at intervals until the tumour is nearly dispersed. The gum catheter should be of small

size: a large one will produce an effect exactly contrary to what you wish, irritating the gland, and exciting a fresh attack of inflammation in it. I have known the attempt made to destroy one of these enlarged follicles by means of the bougie armed with the nitrate of silver; but in the case to which I allude the treatment seemed to be injurious rather than beneficial. It has often occurred to me that the tumour, when not of a very large size, and not very closely attached to the surrounding parts, might be dissected out without injury to the corpus spongiosum or urethra; but I have never yet performed such an operation. In some instances suppuration takes place in one of these tumours, and an abscess bursts externally. The healing of the abscess is generally slow; and after it has healed, an induration remains, which, however, gradually disappears. In other cases it bursts internally, and the cavity of it is liable to become distended by a portion of the urine finding its way into it. Under these circumstances you may direct the patient to place his finger on the part when he makes water, so as to make a moderate pressure on it. Thus the urine will be prevented entering the abscess, which will at last, in all probability, heal. If, however, it should not heal, you may introduce a director into the urethra, and then make an incision in it so as to establish a free external opening, leading to the centre of the abscess, dressing the parts afterwards with some stimulating ointment, and applying occasionally the nitrate of silver.

I have seen one case, in which one of these enlarged glands produced a complete obstruction of the urethra, and a retention of urine. The urethra became ulcerated behind the obstruction; the ulceration extended to the external parts, and the urine became extravasated into the cellular membrane of the scrotum and penis. The patient was admitted into the hospital with extensive mortification of the scrotum and perineum, and died. The examination of the body after death enabled me to ascertain the nature of the disease.

Diseases of the Female Urethra.

Passing over those affections of the male urethra which are connected with syphilis, and gonorrhœa, I shall draw your attention to the diseases of the female urethra. These are few and simple, and, as I have already had occasion to observe, all that is to be said respecting them may be comprised in a very few words.

Stricture of the female urethra is very rare; nor have I ever seen it except at, or immediately within, the external meatus. We have a preparation which affords an example of stricture in this situation. It was taken from the body of a woman who died under the following circumstances:—She was admitted into the hospital labouring under a very great difficulty of making water. The urine was voided almost in drops, with much effort and straining. On examination, I found the external orifice of the urethra so much contracted that it would scarcely admit a small probe. It was, however, dilated by means of bougies, and the patient voided her urine in a moderate stream. Some time afterwards she was seized with an attack of fever, which proved to be dependent on inflammation of the peritonæum covering the liver, unconnected with the disease of the urethra, and of this she died. You will observe in the preparation that the stricture is quite at the extremity of the urethra, occupying about half an inch of the canal.

Sir Charles Clarke has described another disease of the female urethra, of which many examples have come under my own observation. It consists of a tumour, or excrescence, having its origin from the urethra immediately within the external meatus. The tumour projects externally; is of a soft texture; of a bright scarlet colour; possessed of exquisite sensibility; and it varies in size from that of a large pin's head to the size of a horse-bean.

Where this excrescence is of a small size, it may be at once destroyed by the application of the concentrated nitric acid, or the caustic potash. For the purpose of protecting the sound part of the urethra from the action of the caustic, I have contrived the

instrument which I now show you. It is a silver tube of the same diameter as the urethra, having a handle projecting at a right angle at one end, closed and rounded at the other end, and open in one part of its circumference. It is to be introduced into the urethra, so that the morbid growth may project into the open side of the tube. The nitric acid may be applied by means of a probe armed with lint; the caustic potash, of course, is applied in a solid form. If you use the former, you should have at hand a solution of the carbonate of potash, to be applied in case of the caustic flowing over the external parts: if you use the latter, the external parts may be protected by the application of vinegar. Sometimes a single application of the caustic will be sufficient; at other times, the application must be repeated twice or three times, or even oftener. Where the excrescence is of a large size, it may be removed by means of a pair of probe-pointed scissors in the first instance, the caustic being applied afterwards.

Irritable Bladder.

In the greater number of cases of disease of the bladder, the most marked symptom under which the patient labours is a too frequent inclination to void the urine. The bladder is irritable; and those who have not combined with the observation of symptoms the study of morbid anatomy, are apt to confound with each other diseases which are essentially different, under the general appellation of irritable bladder. In the observations which I am about to make, however, I shall apply the term irritable bladder to those cases only in which the irritability is not the consequence either of inflammation or of organic disease.

If healthy urine escapes from the bladder, and comes in contact with other textures, the peritonæum, for example, or the cellular membrane, it acts on these parts as a violent stimulus, inducing inflammation, gangrene, and death: while to the bladder it is no stimulus at all; the patient suffering no more inconvenience from it than he would have suffered if the bladder had been distended with the same quantity of water. If, however, there be any

derangement of the functions of the general system, or of the kidneys, in consequence of which the chemical qualities of the urine are altered, it then becomes a stimulus to the bladder itself; and the patient, under these circumstances, suffers inconvenience, and feels the desire to expel the contents of the bladder, when there is only a small quantity of urine collected in it. In some of these cases the urine contains an unusual quantity of lithate of ammonia, which is deposited, on cooling, mixed with other matter, in the form of a red or yellow uncrystallised sediment; or it may contain the pure lithic acid, showing itself in the form of a red sand. In other cases, the urine is of a turbid appearance, depositing white crystals of the triple phosphate of ammonia and magnesia, and probably alkaline. It is right that I should notice these cases at present, though it be only in a brief manner. For further information respecting them, and the treatment which they require, I must refer you to some of my subsequent Lectures relating to calculus affections.

Irritability of the bladder is occasionally a symptom of disease in, or of disease affecting, the nervous system. An elderly man, for example, complains of frequent attack of giddiness. Sometimes, in walking, his head turns round, so that he is in danger of falling; and this symptom, probably, arises from an altered structure of the arteries of the brain, causing an imperfect state of the cerebral circulation. This state of things is sometimes attended with an irritable condition of the bladder; and, although the urine is of a healthy quality, and the bladder itself is free from disease, the patient is tormented by a constant micturition, voiding his urine without pain, but at short intervals, and in small quantity at a time. You can do little for the patient's relief in such a case as this; but it is important that you should understand its real nature, so that, if you cannot effect a cure, you may avoid tormenting him with useless remedies.

Irritability of the bladder is at other times the result of mere nervousness; of the same state of the nervous system, as, in some other individuals, occasions a constant winking of the eyes, or

twitches of the muscles of other parts. The frequent expulsion of the urine, being once begun, is kept up by habit; the bladder becomes less capacious than it ought to be; and it is not until after a lapse of time, nor without some effort on the part of the patient, that it is restored to its natural condition. Respecting such cases, Dr. Prout observes that 'the functions of the kidney almost always participate in the irritation; and that, on inquiry, the urine is found to be not only increased in quantity, but deranged in its properties; that is, the secretion has a specific gravity below the healthy standard, often approaches to neutrality, and deposits the phosphates on exposure to heat, and is sometimes even slightly serous.'

There are others, who have a tendency to diabetes, and who, overlooking the too abundant secretion of urine, and observing only the too frequent inclination to expel it, consult you under the impression that they labour under a disease of the bladder, while the actual disease is in the kidneys, or rather in the general system. Now, this may appear too obvious a circumstance to be worthy of being mentioned; but I have known it to be a source of error; and I am anxious that, when you meet with such cases, you should not be perplexed in forming your diagnosis.

Paralysis of the Bladder.

Injuries and diseases of the brain and spinal marrow, which render the limbs paralytic, may render the bladder paralytic also. The bladder is not unfrequently affected in the same manner in cases of typhus fever, or where there is a great general excitement in consequence of a compound fracture, or other severe local injury, especially of the lower extremities.

Retention of urine from paralysis of the bladder is attended with symptoms which are, in many respects, different from those which occur where the retention arises from mechanical obstruction. The same diminution of nervous influence, which renders the bladder incapable of expelling the urine, renders it also insensible to its stimulus. Hence it is, that the accumulation of the

urine in the bladder is productive of no actual suffering, and of comparatively little inconvenience. When a great degree of distention has taken place, the contents of the bladder begin to escape involuntarily; and this involuntary flow of urine continues, so as to prevent further accumulation, but not so as to empty the bladder. Being made acquainted with the circumstances which I have just mentioned, you will understand how it is that this kind of retention of urine is not unfrequently overlooked, especially in the cases of corpulent individuals, in whom the bladder may be distended to a considerable size before it can be distinguished by the hand above the pubes.

In some instances, although the bladder has lost its contractile power, the patient is able, nevertheless, to get rid of a portion of its contents, in a stream, by his own natural efforts. This is accomplished by means of the action of the abdominal muscles, but not until the bladder has become enormously distended. Here the urine is expelled at short intervals, slowly, and in small quantity at a time. The patient believes the bladder to be empty, as he probably voids as many ounces of urine as are usually voided in twenty-four hours; and he is surprised to find, on the introduction of the catheter, that it draws off two or three pints, or even a larger quantity. Where this state of things has existed for a considerable time, if the patient dies, and you have the opportunity of instituting a post-mortem examination, you find the bladder very much dilated, the mucous membrane of a pale colour, and the muscular tunic much attenuated.

Where the bladder is affected with paralysis, the patient is to be relieved by means of the catheter: and this is easily accomplished; there being no mechanical impediment to the introduction of the instrument. The operation must be repeated at stated intervals, at the same time that you attempt, by suitable remedies, to remove the cause of the paralysis, whatever it may be.

But it may be reasonable to inquire what will happen if the catheter be not employed. I have known such a retention of urine to exist, some urine escaping, but the bladder remaining

distended, without the real nature of the cause having been understood, for a great length of time; that is, for many months, or even for one or two years. The same overloaded state of the bladder is a still more frequent consequence of the chronic enlargement of the prostate gland, to which elderly persons are liable, as I shall explain to you hereafter. From whichever of these causes it arises, it produces the same effects. The kidneys become diseased; they secrete at first albuminous, and afterwards purulent urine; and other changes are produced in these organs which I need not describe at present, as they will be fully explained hereafter.

Paralysis of the bladder is usually the result of some disease or injury, which affects other muscles as well as that of the bladder. Occasionally, however, it occurs without this complication; the bladder, and (as far as we can see) the bladder only, being deprived of its power of action. A gentleman, a lawyer by profession, of sedentary habits, and of what is commonly called a nervous temperament, observed that he had not the usual desire to void his urine, and that when he did void it, it was in a very slow stream, and in small quantity. On the following day he voided none at all, but he had, at the same time, no inclination to void it, and, therefore, did not suffer. Another day arrived, and, being still in the same condition, he thought it prudent to consult a surgeon; not because he experienced either pain or inconvenience, but because he knew, as he expressed it, that all could not be right. The surgeon introduced a catheter, which entered the bladder without the smallest difficulty, and drew off a large wash-hand basinful of urine. The urine soon became again collected in the bladder, and the catheter was again had recourse to. The operation was repeated night and morning for a few days, at the end of which time the patient regained the power of making water, and was soon able to evacuate the contents of his bladder as usual. Some time afterwards he had another similar attack, from which he recovered more slowly than from the former one.

The paralytic affection of the bladder, which occurs in hysterical

females, is of a peculiar kind, and deserves a separate consideration. It appears to me that the symptoms are to be traced to a still higher source than in ordinary cases of paralysis; that, in the first instance, it is not that the nerves are rendered incapable of conveying the stimulus of volition, but that the effort of volition is itself wanting; and this corresponds with what is observed in cases of loss of voice, and in many other diseases connected with hysteria. As the distention of the bladder increases, the patient begins to be uneasy, and at last suffers actual pain; and as soon as this happens, the volition is exercised as usual, and the bladder begins to expel its contents.

Thus, if the bladder be not relieved artificially, by the introduction of the catheter, the hysterical retention of urine is usually of short duration. If, however, the catheter be had recourse to, the natural cure is prevented, and the existence of the disease may be prolonged for an indefinite period of time—for weeks or even for months. The general rule to be observed in the treatment of these cases is to interfere but little. You may administer an active aperient, or an assafœtida enema, or you may give assafœtida by the mouth, but you should avoid using the catheter. This general rule, however, is not without its exceptions. In a few of these cases, where the bladder has been very much distended, the consequence of this over-distention is, that it loses its power of contraction, and, even though the patient endeavours to make water, no urine flows. Under these circumstances it is evident that artificial relief is necessary; and if it be not afforded, something worse than a mere inconvenience may be the result. A young woman was admitted into St. George's Hospital, in November 1814, labouring under a train of symptoms which I believe to have been connected with the same condition of the nervous system as that which produces the phenomena of hysteria. I should be wandering from my subject, if I were to relate to you all the circumstances of this interesting and important case. It is sufficient for our present purpose that you should be informed that one of the symptoms was a retention of urine, which had been

long neglected, and which existed to such an extent, that forty ounces of urine were drawn off by the catheter; and that the patient ultimately died. In my notes I find the following account of the appearances which the bladder presented in the post-mortem examination:—'It was of a very large size, as if it had been for a long time unusually dilated. It was throughout of a dark colour, almost black. There were only some slight vestiges of its natural structure left; the muscular fibres being very much wasted, and the internal membrane presenting the appearance of a very thin film, which was readily separated from the parts below. The dark colour of the bladder did not seem to arise from mortification, since there was neither fœtor, nor any other mark of putrefaction.' The state of the bladder was, indeed, very peculiar; not resembling anything which has fallen under my observation either before or since.

Inflammation of the Bladder.

You will find in practice that acute inflammation of the bladder is of much less common occurrence than you would suppose it to be, from what is said on the subject by nosological writers. Cases of retention of urine, and cases of inflammation of the prostate gland, are not unfrequently mistaken for it by persons who are not very conversant with the diseases of the urinary organs.

Acute inflammation of the bladder does, however, occur sometimes. You have especially the opportunity of seeing it in cases of gonorrhœa. Where there is a sudden suppression of the discharge from the urethra, the metastasis takes place, sometimes to the testicle, sometimes to the prostate gland; at other times, but less frequently, to the mucous membrane of the bladder. The patient has a frequent desire to void his urine, with a sensation as if there were urine in the bladder, when there is really no urine in it; and he strains to make water with the bladder empty. There is pain referred to the region of the pubes and perineum. The urine deposits a sediment, which is of a different character in

different cases, as I shall explain hereafter. The pulse is frequent, the tongue furred, and there is a good deal of constitutional excitement. These symptoms may continue for several days; and in cases of gonorrhœa they do not usually subside until the purulent discharge from the urethra is restored.

The disease is to be combated by taking blood from the arm, or from the loins by cupping, or from the lower part of the abdomen by leeches. The patient should be confined to bed and the horizontal posture. His bowels should be kept open by occasional doses of castor oil. Opium may be administered with advantage, especially in the form of clysters. Sometimes the urine retains its acid quality, turning the blue litmus paper red; and the sediment, which it deposits, is of a yellowish colour, having no adhesive quality, and apparently purulent; and in these cases, if I am not much mistaken, the patient will derive benefit from the use of mercury,—two grains of calomel, and half a grain of opium, being administered twice or three times daily. In other cases, the urine is alkaline, turning the reddened litmus paper blue, and depositing a small quantity of adhesive mucus of a brownish colour; and, under these circumstances, I have known much good to arise from the use of the vinum colchici, fifteen or twenty minims being given three times daily, for three or four successive days.

Chronic inflammation of the bladder occurs very frequently as a secondary disease, depending on long-continued stricture of the urethra, disease of the prostate gland or kidneys, or stone in the bladder. Women are also liable to it, in whom there exists an ulcerated communication between the bladder and vagina. As a primary affection, it is comparatively rare. However, it occurs as such sometimes; and I have seen a few patients in whom it had existed for a considerable length of time, and could not be traced to any other disease.

I shall describe to you, first, the appearance which the diseased parts exhibit on dissection; secondly, the symptoms which the disease produces; and, lastly, the treatment which it requires.

The mucous membrane is of a dark red colour, in consequence of its numerous vessels ramifying on its surface, injected with their own blood. As the disease proceeds, the discolouration becomes greater, until, at last, the mucous membrane appears almost black from the turgid state of the vessels; at the same time that it is somewhat thickened and pulpy to the touch. The inflammation extends up the membrane of the ureters; which, in their turn, assume much the same appearance with the bladder itself. The pelvis of each kidney, and the processes of the pelvis, or infundibula, become inflamed also: and these, as well as the ureters, are generally dilated, so as to be more capacious than natural. This dilatation is greatest where there has been a long-continued difficulty in expelling the urine from the bladder; but it exists in other cases also, though in a less degree. In the advanced stage of the disease the inflammation is found to have extended to the glandular structure of the kidneys; and these organs become not only more vascular than natural, but enlarged in size, and of a soft consistence, even approaching in appearance to that of a medullary tumour. Collections of muco-purulent fluid, tinged brown with grumous blood, and offensive to the smell, are sometimes found in the dilated infundibula; at other times there are distinct abscesses in the glandular structure. In cases where the disease is still farther advanced before the patient dies, we find that the inflammation has extended to the muscular tunic of the bladder, and to the loose cellular membrane by which the bladder is surrounded. Then coagulated albumen is deposited in the cellular texture; not unfrequently small putrid abscesses are formed in it; and sometimes it is found after death in a state of slough, or approaching to it. Occasionally, but rarely, ulceration takes place on the inner surface of the bladder, and sometimes to a very great extent. A patient, about 50 years of age, died in St. George's Hospital, labouring under the symptoms which I am about to describe. On examining the body, the mucous membrane was found destroyed everywhere, except a very small portion near the neck of the bladder. The muscular fibres

were as distinctly exposed as they could have been by the most careful dissection. The prostate gland in this case was slightly enlarged; the mucous membranes of the ureters and pelves of the kidneys were much inflamed, and the ureters were dilated. I remember a preparation, exhibiting nearly the same appearances, in Dr. William Hunter's Museum, which was formerly in Windmill Street, but which is now in Glasgow.

As chronic inflammation of the bladder is, in the majority of cases, not a primary but a secondary affection, the symptoms of it are generally blended with those of another disease, as of stone in the bladder in one case; of stricture in the urethra, or enlargement of the prostate, in another case. I shall endeavour to describe the symptoms as nearly as I can, distinct from those of the diseases which it accompanies, such as you find them to be in those cases, in which the inflammation of the bladder is the only existing malady.

The patient has frequent desire to void his urine, and the urine deposits, as it cools, a thick adhesive mucus, which clings to the bottom of the vessel. This mucus is of a greyish colour, often exhibiting white streaks arising from a deposition in it of the phosphate of lime, and sometimes tinged with blood. There is pain previously to making water, and also while the urine flows. These symptoms may continue for a great length of time without becoming very urgent. However, they gradually increase, until the irritation of the bladder becomes excessive, the quantity of mucus deposited being so great, as in some cases to be nearly equal to that of the urine itself. In this last respect, however, there is a great difference in different cases. The urine ultimately assumes a brownish hue, and is of a most offensive ammoniacal odour. The extension of the inflammation to the glandular structure of the kidneys is indicated by the access of a still more formidable train of symptoms. The patient has shiverings; is troubled with sickness and vomiting, with cold extremities and great prostration of strength; his pulse becomes irregular and intermitting; his tongue brown; he sinks, and dies. In the case

which I mentioned, in which the bladder was extensively ulcerated, there was excruciating pain referred to the perineum and urethra, especially after making water; and the introduction of a sound into the bladder occasioned excessive torment. The symptoms which existed in the patient whose ulcerated bladder is preserved in Dr. William Hunter's Museum, are thus described in Dr. Hunter's catalogue:—'Great pain and scalding in voiding the urine, a discharge of pus, and occasionally of blood.'

The mucus, which is deposited by the urine in these cases, deserves our especial notice. It is thick and viscid, clinging to the bottom of the vessel, and hanging down in the form of long ropes when you attempt to pour it from one vessel to another. It is highly alkaline, turning the turmeric paper immediately brown. When small in quantity, although the mucus is alkaline, the urine often remains acid, as has been observed by Dr. Prout; but when the quantity of mucus is large, it imparts its alkaline quality to the whole of the urine. The mucus itself, as I have already mentioned, deposits the phosphate of lime, sometimes in distinct masses resembling mortar. When the urine is rendered alkaline under its influence, crystals of the triple phosphate of ammonia and magnesia are generated in it, which become blended with the phosphate of lime of the mucus, forming the fusible calculus, as I shall explain hereafter. It is the formation of this peculiar mucus which led the old physicians and surgeons to apply to this disease the name of catarrhus vesicæ. It may appear remarkable that the mucous membrane of the bladder, when in a state of inflammation, should secrete this peculiar mucus, while that of the urethra, under the same circumstances, secretes a fluid which cannot be distinguished from true pus. The very interesting researches of Dr. Babington, however, recorded in the second volume of the 'Guy's Hospital Reports,' go far towards explaining this anomaly, by showing that the pus from a common abscess assumes all the characters of this kind of mucus on the addition of an alkali.

In the treatment of chronic inflammation of the bladder, you

are to consider whether it be a primary or secondary affection; and if the latter, the first thing to be done is, that you should remove or palliate the original complaint. If there be a stricture, you are to dilate it: if there be a stone in the bladder, you will in vain endeavour to remove the inflammation, without removing the stone which has produced it: if there be a disease in the prostate gland, you are to resort to the treatment which I shall describe to you in a future lecture.

But even in these cases something may be done by other means towards relieving the affection of the bladder; and where this is the original disease, of course these other means are all on which you are to depend.

Let the patient remain as much as possible in the horizontal posture. When he sits or stands there is the weight of the whole column of blood, from the head to the pelvis, pressing on the vessels of the bladder; and bloodvessels become distended, which are comparatively empty when he lies down. The horizontal position is as important in diseases of the bladder as it is in diseases of the uterus; as important as an elevated posture and a high pillow are in cases of determination of blood to the head; and its importance rests on precisely the same principle.

Opium agrees remarkably well with patients who labour under chronic inflammation of the bladder. It may be administered by the mouth, or in the form of an enema, at bedtime; and other sedatives, as the extract of hyoscyamus, or lettuce, or poppies, may be administered besides, if necessary. The bowels should be kept in an open state, but no violent or drastic purgatives should be exhibited. Mercurial remedies, whether given in the form of alteratives or in larger doses, so as to affect the constitution, are certainly not beneficial, and are often injurious.

In some instances, where the digestion is impaired, alkaline remedies combined with light bitters may be exhibited with advantage; but large doses of the alkalies are prejudicial, causing the urine to become more alkaline, and the phosphatic salts to be deposited in larger quantities than before.

The uva ursi has the reputation of being useful as a remedy for chronic inflammation of the bladder. I must say, however, that this remedy has generally disappointed me in these cases, and that I have not seen those advantages produced by it which the general reputation of the medicine had led me to expect. I have seen much more good done by a very old medicine, which has been long ignominiously, but unjustly expelled from the Pharmacopœia of the College of Physicians, namely, the root of the pareira brava; and with regard to this, I am satisfied that it has a great influence over the disease which is now under our consideration, lessening very materially the secretion of the ropy mucus, which is in itself a very great evil, and, I believe, diminishing the inflammation of the bladder also. It may be exhibited in the following manner:—Take half an ounce of the root of the pareira brava, add three pints of water, let it simmer gently, near the fire, until reduced to one pint.* The patient is to drink from eight to twelve ounces of this decoction daily. If so large a quantity of liquid should be offensive to the patient's stomach, he may take the extract of pareira brava instead, twenty-five or thirty grains being equal to half a pint of the decoction. You may add to it moderate doses of the tincture of hyoscyamus; and in those cases in which there is a deposit of the phosphates, you may also add some of the muriatic or nitric acid. With respect to the use of acids, however, in such cases, I may observe that my experience leads me to have much less faith in their efficacy where the alkaline condition of the urine is connected with the secretion of an alkaline mucus from the mucous membrane, than when the urine has been secreted alkaline in the kidneys. Very small doses of turpentine are sometimes beneficial in these cases. You may begin with four or five grains of Chios turpentine administered twice daily, giving a somewhat larger quantity afterwards. I have sometimes known the symptoms to be much alleviated under the

* The infusion of pareira brava, which has been introduced into the last Pharmacopœia of the College of Physicians, does not at all answer the purpose of the decoction, and is nearly useless. 1849.

use of the cubebs pepper: but it must be given only in small quantities: and, when given in large doses, I believe it to be actually injurious. I was consulted by a gentleman who laboured under chronic inflammation of the bladder, and I prescribed for him fifteen grains of the powdered cubebs to be taken every eight hours. He was very much relieved, so much so that he began to look forward to his recovery. Being anxious to expedite his cure, of his own accord, and without my knowledge, he took the cubebs in larger (I believe in drachm) doses. This was followed not by a diminution, but by an aggravation, of all his symptoms. The irritation of the bladder was much increased, the mucus was secreted in a much larger quantity than before, and ultimately the patient died; his death being, I will not say occasioned, but apparently very much hastened, by his imprudence in overdosing himself with the cubebs.

The bladder is accessible to local applications, and the question will here arise, 'Can nothing be done for the patient by means of remedies of this description?' The following are the results of my experience on this subject.

In aggravated cases of the disease, where the symptoms are at their greatest height, the mildest injections, even those of tepid water, will do harm rather than good. They are especially to be avoided where the mucus deposited by the urine is highly tinged with blood. When, however, the symptoms have in some degree abated, the injection of tepid water or decoction of poppies is in many instances productive of excellent effects. An elastic gum catheter may be introduced into the bladder, and the injection may be made by means of a small elastic gum syringe. The liquid should be allowed to remain in the bladder about thirty or forty seconds, and not more than an ounce and a half, or two ounces, should be injected at each time. If the bladder be distended, so as to occasion any considerable degree of pain, the effect is always injurious instead of being beneficial. This operation may be repeated, according to circumstances, once or twice in twenty-four hours.

When there is a further abatement of the symptoms, the disease having assumed a still more chronic form, and the mucus being free (except on extraordinary occasions) from all admixture of blood, we may venture to add to the injection a very small quantity of nitric acid. At first the proportion ought to be not more than that of one minim of the concentrated, or ten minims of the diluted nitric acid, to two ounces of distilled water; but afterwards this proportion may be doubled. I do not say that it should never be increased still further, but I have observed, that for the most part injections, which are stronger than this, are not only not useful but actually prejudicial. In having recourse to this mode of treatment, it is better to begin with washing out the bladder with a little tepid water; then to inject the acid solution, allowing it to remain for not more than thirty seconds in the bladder. At first the operation should not be repeated oftener than once in every two days; afterwards it may be repeated once daily, but never more frequently than this. If the urine drawn off by the catheter be tinged with blood, the injection should be deferred to the following day; and if the injection be at any time followed by pain, and other symptoms indicating an increase of inflammation, it ought not to be had recourse to again until these have subsided.

I was first led to adopt the use of the injections of nitric acid in the year 1826; and from the experience which I have now had of them, I do not hesitate to say, that, if the precautions, which I have suggested, be properly observed, they will be found to form an useful addition to our stock of remedies to be employed in these cases. They are useful not only where the chronic inflammation is the primary disease, but also where it occurs as a secondary affection, the result of a calculus in the bladder, or of a chronic enlargement of the prostate gland.

It may be observed that, although treating of chronic inflammation affecting a mucous membrane, I have not hitherto recommended the abstraction of blood. I have, however, formerly had recourse to it in several instances, generally by means of the

application of cupping glasses to the loins. I will not say that it has never been beneficial, but it is my duty to say also, that I have much more frequently found it to be injurious. However contrary it may seem to be to the principles on which the treatment of inflammatory diseases is generally to be conducted, I am satisfied that in those cases of inflammation of the bladder in which the mucous membrane secretes a considerable quantity of thick, tenacious, ropy mucus, falling to the bottom of the vessel in which the urine is received, the rule of practice should be, not to take away blood; and that this admits of very few exceptions. In fact, this species of vesical inflammation is, in the great majority of cases, combined, in some way or another, with great debility of the general system, so that the patient requires that his bodily powers should be supported, rather than that any demand should be made upon them. I may refer you to my Lectures on Calculous Disorders for some observations in further illustration of this subject.

In speaking of inflammation of the bladder, I have considered it as being either of the acute or chronic kind; not only in compliance with general custom, but because I could not otherwise so conveniently express all that is required to be said on the subject. At the same time it is right for you to bear in mind, not only on this, but also on other occasions, that, however convenient it may be to make it, this distinction is really artificial. The boundaries of acute and chronic inflammation are not well defined. There are numerous cases in which we may well hesitate to say whether they may with most propriety be referred to one class or to the other; and there are other cases, which, while, at one period, they exhibit all the marks of acute inflammation, exhibit, at another period, those of chronic inflammation with equal distinctness.

Gouty Affections of the Bladder.

There is a class of cases which occur especially among those who lead indolent lives, indulging at the same time in the luxuries of the table, in which we cannot doubt that the symptoms are

connected with that state of the general system which produces the phenomena of gout; and it is very important that you should distinguish such cases from those of simple inflammation, or of irritable bladder, which I have already described.

The patient complains of uneasy sensations referred to the region of the pubes; he feels the desire to void his urine when only a small quantity is collected in the bladder; and there is pain in the neck of the bladder, and along the urethra, both while the urine flows and afterwards. These symptoms vary in intensity, sometimes disturbing the patient once in one or two hours, leaving him tolerably at ease in the intervals, at other times harassing him almost perpetually, so that he is jumping out of bed, and straining to make water with great suffering, every ten or fifteen minutes. In the more aggravated cases there is pain in the loins, extending from thence to the groins. The urine is, for the most part, secreted in small quantity; exhibiting a large deposit of lithate of ammonia as it cools; the deposit being sometimes of a yellow, and at other times of a red, colour, and in the latter case leaving a deep red stain in the vessel.

It is probable that, in these cases, the symptoms are to be attributed partly to gouty inflammation, and partly to the highly stimulating quality of the urine flowing over the mucous membrane. However that may be, the sufferings of the patient under such an attack are often very severe. Fortunately the disease is much under the dominion of art. The treatment which I have generally found to be the most successful is the following.

In the first instance I prescribe a pill of calomel combined with James's powder, and with two or three grains of the extractum Colchici aceticum to be taken at bedtime, followed by an active aperient draught on the following morning. When the latter has ceased to operate I give a saline draught with fifteen minims of the vinum Colchici, to be taken twice or three times daily, according to the urgency of the case. I repeat the mercurial and other purgatives, according to circumstances. In very severe cases a dose of the Pulvis Ipecacuanhæ Compositus or some

other opiate may be given at bedtime. Under this treatment, combined with a moderate diet, and abstinence from acids, fruit, and fermented liquors, the symptoms for the most part are very soon relieved, and subside altogether in the course of a few days.

Incontinence of Urine.

By incontinence of urine, I intend to express an involuntary escape of urine from the bladder; a state of things entirely different from the frequent discharge of urine which takes place in cases of irritable bladder, where each discharge is the result of a distinct act of volition, excited by pain, or in some other way.

Incontinence of urine may be the result of mechanical injury; thus it occasionally follows the operation of lithotomy in the male, and very frequently follows it in the female sex. In women also it not uncommonly is the consequence of difficult parturition with a distended bladder, where the pressure of the child has caused sloughing of the vagina, and thus laid the foundation of a communication between it and the neck of the bladder.

The most frequent cause of incontinence of urine, however, in the male sex, is an over-distended bladder. When the patient is unable to void his urine voluntarily, after a certain quantity is collected in it, the overplus is discharged involuntarily, and thus it is that this symptom occurs in cases of long-standing stricture of the urethra, of enlarged prostate gland, and of paralysis affecting the lower part of the body. The patient, and those about him, suppose the bladder to be empty, because the urine is always dribbling from him. But this very circumstance leads the surgeon to suspect the contrary; and accordingly, on examining the abdomen, he discovers an enormous tumour, formed by the distended bladder, occupying the hypogastric region, and extending upwards, perhaps as high as the navel. The remedy for this kind of incontinence is sufficiently obvious; nothing more being required than that the bladder should be emptied artificially at stated periods. In cases of stricture of the urethra, indeed, this cannot be always accomplished in the first instance; but the

dilatation of the stricture, even to a very moderate extent, by the introduction of a small bougie, will often be sufficient to give much, if not complete, relief.

There are some cases of paralysis in which there is incontinence of urine, although the bladder is empty, as if the same cause which rendered the lower limbs paralytic rendered the bladder incapable of distention. For example, a gentleman, 63 years of age, swallowed by mistake a bottle of liniment, of which the tincture of cantharides was a principal ingredient. In about three-quarters of an hour an emetic was administered; nevertheless he was immediately afterwards affected with paralysis of the lower extremities, and inability to void his urine. For the first fortnight he was under the necessity of having his urine drawn off at stated periods. After this he regained the power of making water, but was tormented by an incessant desire to do so. When I was consulted, four years after the commencement of the attack, he was able to walk with the assistance of crutches. At times he had a sudden and irresistible impulse to void his urine, and expelled a small quantity by a voluntary effort; but at other times it flowed involuntarily, without his being conscious of what happened, so that his clothes were as wet as possible. On introducing a catheter, I found that the bladder was empty. It may be supposed, that in this case something was to be attributed to the peculiar nature of the stimulus which had been swallowed. I have, however, observed the same thing in some cases of paralysis of the lower limbs, arising from other causes. I have occasionally seen what was called a case of incontinence of urine in young women having a disposition to hysteria: but in which the result of a close observation was to satisfy me that the discharge of urine, although involuntary in appearance, was not involuntary in reality; and that this symptom, like many other hysterical symptoms, was to be referred to a mis-direction of the power of volition, and not to the actual want of it. The case which I am about to mention seems to confirm this view of the subject. A lady, 20 years of age, for the last ten or eleven years had been troubled with a

constant discharge of urine. It flowed (as she said) without her being able to prevent it while she sat in her chair, and while she was walking; so that she was quite unfit to live in society, or even in her own family. All the plans of treatment recommended by myself and others, proved inefficacious. At last, on account of this infirmity, it was thought advisable that she should be separated from the rest of her family, and she was sent to reside at a distance from them. After some time she was seized with an urgent desire to return home, and immediately she regained the power of retaining her urine. She continued well when I heard of her some time afterwards.

The incontinence of urine during the night (occurring independently of any other disease), to which some children and even adults are liable, may generally be attributed to a very abundant secretion of urine, combined with so sound a sleep that the individual is not roused from it by the feeling of the distended bladder. It seems in children sometimes to be not altogether involuntary in its origin; but even in these cases it soon becomes confirmed by habit, and then the discharge is preceded by so slight an effort of volition, that the patient is scarcely conscious of it afterwards. It is reasonable to suppose, that those children whose urine is of a too stimulating quality, in consequence of an excess of lithic acid in it, may be more liable to this kind of incontinence than others; yet I must say, that my endeavours to relieve it by the exhibition of alkalies and purgatives, combined with a regulated diet, have been generally unsuccessful. A blister applied over the os sacrum, and repeated according to circumstances, is a more effectual remedy. Sir Charles Bell has observed, that children are more liable to this troublesome symptom when they lie on their back than when they lie on the face or side. This may explain, in part at least, the good arising from the blister. The same object may be attained by making the child wear, during the night, a machine, so contrived as to prevent him lying in the supine posture.* I know that you cannot absolutely rely

* A very convenient apparatus for this purpose is made by Mr. Sparks, bandage-maker, &c., of No. 28 Conduit Street.

on this method for the patient's cure, but it may often be employed advantageously, in combination with other methods of treatment. It is plain that one effect of drinking an inordinate quantity of liquid must be to aggravate this infirmity; and this circumstance furnishes a sufficient reason, in addition to others, why this habit should be avoided. In some cases, the discharge of urine is periodical, returning at the same hour of the night and morning. You may then direct the nurse to take the child out of bed, so as to give him the opportunity of making water about an hour before; or, if the patient be older, he may be provided with a clock, having a loud alarum, for the purpose of awakening him from his sleep at the proper moment. Under the same circumstances the sulphate of quinine may be administered with great advantage. But in no instance are any of these remedies likely to be successful, unless the patient himself feels a strong desire to be relieved; and unfortunately this desire is not unfrequently wanting, long habit gradually reconciling the mind to this as it does to many other inconveniences, until, at last, it seems to be a matter of indifference whether relief is obtained or not. I have heard of young persons being cured of this kind of incontinence of urine by applying caustic to the neck of the bladder, and by the introduction of bougies or catheters. If these methods of treatment produce any effect, I suspect that it is simply by annoying the patient, and by giving him that strong desire to be relieved, which I have just mentioned as the first step towards recovery.

LECTURE VI.

FÆCULENT DISCHARGE IN THE URINE.

I HAVE explained in a former lecture how, in some cases of stricture of the urethra, a fistulous communication is established between the urethra and the rectum, through which there is an occasional escape of air, or even of fæculent matter from the latter into the former of these passages. In such cases the fæculent matter is always small in quantity, and only occasionally perceptible, and the discharge is seldom productive of any very serious inconvenience to the patient.

There are other cases in which the admixture of fæces with the urine is the consequence of a preternatural communication of some portion of the intestine, not with the urethra, but with the bladder itself. In some instances the fæculent discharge is often not only constant but abundant; the quantity, however, varying according to the size of the fistulous opening.

Dr. Addison and myself were consulted respecting a lady who laboured under this distressing symptom, consequent on a dysenteric state of the bowels, from which she had suffered during the four preceding years.

The commander of a merchant-ship was at sea during a storm, in which his ship was in considerable danger, causing him to be constantly occupied, so that he could scarcely obtain any rest for several successive days and nights. Probably the anxieties which he experienced, and the exertions which he was required to make, were the occasion of his overlooking the early symptoms, which he could not easily have failed to notice otherwise. However that may have been, soon after the storm had subsided, he was surprised

to find an escape of air with the urine. This was followed by a flow of dark-coloured urine, depositing what was evidently fæculent matter. Some time afterwards he came under my care, voiding the same kind of urine, and labouring under urgent symptoms of inflammation of the mucous membrane of the bladder. With these symptoms he sank and died. On examining the body after death, I found several folds of the small intestine adhering to each other and to the fundus of the bladder, and an ulcerated opening of considerable size, by which the intestine and the bladder communicated with each other.*

The pathology of such cases seems to be sufficiently obvious. Ulceration takes place in the mucous membrane of the intestine, and while it is going on, adhesion takes place between the peritonæal tunic of the intestine and that covering the fundus of the bladder. Then, as the ulceration proceeds, it extends through all the various structures into the bladder itself. The disease bears a near resemblance to the fæculent abscess which occasionally occurs in the right groin in connection with the cæcum; the only difference being that it has a different situation, and that another order of textures is implicated in it.

I have never yet met with a case of this kind in which a cure was effected: and in all those of which I have known the result, the patients have ultimately died. Indeed, it seems difficult to say what plan of treatment can be had recourse to with any reasonable prospect of success. In one case, in which, from the small quantity of fæculent matter which the urine contained, I was led to believe that the communication with the intestine was of a small size, I tried the experiment of leaving a large elastic gum catheter in the urethra and bladder, intending that the urine should constantly drain off through it, so as to keep the bladder in a permanently contracted state. I had hopes that, under these

* In the 41st and 42nd volumes of the 'Medico-Chirurgical Transactions,' I have recorded a case similar to the above, in which a phosphatic calculus (the nucleus being vegetable matter) had formed in the bladder, and which I removed by lithotrity.—C. H.

circumstances, the fistulous opening might become gradually closed. The deposit in the urine, however, did not sufficiently escape through the catheter, and clogged the instrument. The catheter thus became a further cause of irritation of the bladder, and I was compelled to withdraw it. The patient left London and ultimately died.

Fungus Hæmatodes of the Bladder.

Morbid growths, having the same character, and running the same course with malignant diseases in other textures, are not uncommonly met with in the bladder. Those which I have had the opportunity of examining have belonged to the class of fungus hæmatodes. Sometimes a portion of the tumour has resembled scirrhus; but I have never met with one which was wholly of the last-mentioned structure. In one instance I found the tumour situated at the fundus; but the more ordinary situation of it is near the neck of the bladder.

The disease appears to have its origin in the mucous membrane: sometimes occupying the whole of it, so that scarcely any of the natural structure remains at the time of the patient's death, but more frequently it arises from a limited portion of its surface, while the greater part of the membrane remains in a healthy state. As the disease advances, it forms a large tumour projecting into the cavity of the bladder. In some instances it makes its way in other directions. In a case, in which the tumour was situated at its fundus, the bladder had contracted adhesions to the sigmoid flexure of the colon, and there was a large fungus projecting from it into the cavity of that portion of the intestine. In another case, some time before the patient died, a tumour presented itself in one groin, which rapidly increased to a considerable size. In examining the body after death, there were found scarcely any remains of the natural structure of the bladder. Nearly the whole of it was converted into a mass of fungous or medullary substance, occupying the cavity of the pelvis, and extending laterally to the groin.

In these cases the patient complains of a too frequent inclination to void his urine; of an uneasy sensation referred to the neck of the bladder, which sometimes amounts to severe pain extending to the perineum, and along the urethra to the glans, and in another direction to the pubes. This pain is generally aggravated after the urine is voided. I have known the patient to labour under a retention of urine, in consequence of the tumour pressing on the inner orifice of the urethra, so that it became necessary to puncture the bladder above the pubes. In another case there was a constant wearing pain in the loins, the cause of which was explained by the appearances observed in the post-mortem examination, the tumour having obstructed the orifices of the ureters, which were in consequence dilated to the size of the small intestine, the pelvis and infundibula of the kidneys being dilated also, so as to form considerable sacs or pouches, distended with urine.

The urine is usually turbid; sometimes depositing an adhesive mucus, the consequence of inflammation kept up by the tumour in the mucous membrane of the bladder. In the advanced stage of the disease the urine is of a dingy brown colour, of an offensive cadaverous odour; and small fragments of medullary substance, which appear to have been separated from the surface of the tumour, may be detected in it. In all cases there is a disposition to hæmorrhage; and in some, bloody urine is a constant, or nearly constant, symptom. The urine is not merely tinged with blood, but the blood comes away in large clots, of an irregular shape, in which small portions of medullary substance are not unfrequently enveloped. The hæmorrhage is occasionally abundant, so that it materially contributes to the gradual exhaustion of the bodily powers, which the disease otherwise induces, and hastens the patient's death.

These symptoms do not always occur in the same order; nor is the rapidity of their progress the same in all cases. I have known the disease to have run its course, so that the patient has fallen a victim to it, in the short space of eight or ten months from the

period of its commencement; and I have also known it to be protracted for seven or eight years. Usually, the first symptoms are a too frequent inclination to void the urine, and pain experienced after it has been voided; but, occasionally, the earliest warning which the patient has of the calamity under which he labours, is the appearance of blood in the urine. I have known the urine to be bloody for a short time, then to become clear, and continue so for one or two years, when the blood has again shown itself, never wholly disappearing afterwards.

In those cases in which fragments of organised medullary substance are to be detected in the urine, there can be no difficulty in the diagnosis; but where this symptom is wanting, each case requires to be observed and studied, in order that it should be understood, as all the other symptoms are equivocal. In the very great majority of instances in which there is blood in the urine, the hæmorrhage is the result of a calculus either in the kidney or bladder; but if there be no calculus, and the quantity of blood be considerable, it is more probable that it is derived from a fungous tumour, than from any other source. If the blood appears in the form of large masses of coagulum, of an irregular shape, we may be satisfied that it flows from the bladder, and not from the kidneys, and we may arrive at the same conclusion, if we find that a small quantity of pure blood is discharged from the urethra after the effort made to expel the last drops of the urine. If under t ese circumstances the bladder be subjected to two or three careful examinations with the sound, and no calculus can be detected in it, there are strong grounds for suspecting the existence of a medullary tumour. These suspicions will be strengthened if the hæmorrhage be accompanied with a frequent inclination to make water, and a pain extending along the urethra and to the perineum, after the urine has flowed; and if the tumour be of a large, or even of a moderate size, they may be completely confirmed in another way. Let about six ounces of tepid water be injected into the bladder; a sound, which is considerably curved, but not extending at the point much beyond the curvature, being

introduced into it afterwards. With such a sound as this every part of the bladder may be readily explored; and the extremity will be distinctly perceived striking against the tumour, at the same time that that side of the bladder in which it is situated is found to be of less capacity than the other. In using a silver catheter in this manner, small portions of the substance of the tumour are sometimes found sticking in the eyes, or lateral openings, of the catheter, after it has been withdrawn.

Fungus hæmatodes is not more under our control where it affects the bladder than where it occurs in other organs; and no method which art has hitherto devised affords us the means of even checking the progress of this horrible malady. Rest in the horizontal posture, and opium administered, according to circumstances, either by the mouth or in the form of enema, will do as much as can be done towards mitigating the patient's sufferings. If there be considerable hæmorrhage, and the pulse be full and strong, blood may be taken from the arm, or from the loins by cupping. Otherwise the mineral acids, the super-acetate of lead, or other styptics may be given internally. On the whole, it has appeared to me that the mineral acids have done more than any other medicine towards stopping the hæmorrhage.

Other morbid growths occasionally take place in the bladder. I have seen a case in which a fungus grew from a portion of the mucous membrane, having somewhat of a fibrous structure, and a good deal resembling in appearance the vessels of the placenta when unravelled. In Dr. William Hunter's Museum there is a preparation of a bladder, the inner membrane of which is, in several parts, elongated into laminæ or processes, each about a quarter of an inch in length. I cannot undertake to point out to you in what manner such excrescences are to be distinguished from each other in the living body; and as all such cases are equally beyond the reach of remedies, such distinction, even if it could be made, would be of little practical importance.

Symptoms affecting the Bladder in consequence of Disease in the Kidney.

Calculi of the kidney occasionally produce symptoms, which are referred to the bladder rather than to the kidney. I shall have occasion, in a future lecture, to notice a well-marked example of this fact, which occurred in my own practice; and you will find others referred to by Morgagni. 'A patient,' says this eminent pathologist, 'complained of very little pain in the region of the kidney; while he was tormented with pain in the bladder so excruciating, that five or six physicians who attended him entertained no doubt that the seat of the disease was in that organ. On dissection, however, no morbid appearance whatever was discovered in the bladder, but there were large and ramifying calculi of the kidney.'

If calculi of the kidney produce symptoms which may easily be mistaken for those of disease in the bladder, it may reasonably be expected that some other disease of the kidney should affect the bladder in the same manner. Many years have elapsed since I was first led to suspect this to be the case, and the result of all the experience which I have since had has been to remove whatever doubts I might formerly have entertained on the subject. Whoever is much engaged in this branch of surgical practice will meet with a number of facts which cannot so well be explained on any other hypothesis, and which collectively form such a mass of circumstantial evidence, as is almost irresistible, in favour of the opinion 'that the worst symptoms of irritable bladder may occur as a consequence of disease of the kidney, the bladder itself, and the organs in immediate connection with it, having been free from disease in the first instance.'

The opportunities of obtaining direct or positive evidence (that is, by means of post-mortem examination) on a point like this, are of comparatively rare occurrence; for so intimate is the union of the different organs which constitute the urinary system with each other, that disease can scarcely exist for a great length of time in

one of them, without extending in a greater or less degree to the rest. Such opportunities are, however, occasionally met with where the patient has died before the disease has reached its most advanced stage; and I am able to adduce the following histories in illustration of the foregoing observations.

A gentleman consulted me in November 1833, labouring under the following symptoms:—He voided his urine frequently, and in quantities varying from an ounce to an ounce and a half. Always after making water he had a severe pain lasting a few minutes, and extending along the course of the urethra. The urine was pale, semi-opaque, of an acid quality, and, when tested with heat and nitric acid, it was found to be highly albuminous. Occasionally, small masses of a substance resembling coagulated albumen were seen floating in it. He made no complaint of pain in the loins; he was able to empty his bladder by his own efforts, and the urethra was free from stricture. There was no calculus in the bladder, nor had sand or gravel ever been observed in the urine. These symptoms had begun to exist in the preceding February, since which time they had gradually increased. For a short time during the month of March, the urine had been tinged with blood.

In addition to these local ailments, the general health was much impaired: the patient had lost flesh, was languid, depressed, and of a pallid countenance.

Soon after I was consulted the urine became again tinged with blood. The bodily powers continued to fail, and the local symptoms became more urgent. There was a total loss of inclination for food, the extremities became cold, the pulse feeble, and he died at the end of February 1834.

On examining the body after death, the kidneys were found to be of a dark colour from excessive vascularity, and of a soft and somewhat brittle consistence; the distinction between the cortical and tubular positions being less marked than under ordinary circumstances. The investing membrane of the kidney had a very slight adhesion to the kidney itself, but it adhered very

closely to the adipose substance of the loins. On the surface of each kidney, and partly imbedded on its substance, were four or five membranous cysts, each of the size of a large pea; and in one of them there was a similar cyst, but as large as a nutmeg, completely imbedded in the cortical substance. The pelvis, infundibula, and ureters were not more capacious than under ordinary circumstances; but, on their being slit open, their internal membranous surface presented the appearances of considerable inflammation.

It could not be said that the bladder was found altogether free from disease, but the morbid appearances were so slight, compared with those observed in the kidney, that it seemed impossible to doubt that the last-mentioned organ had been the seat of the primary disease, and that the latter was affected only in a secondary manner. It was contracted, and the muscular tunic was somewhat thickened; but not more so than must have been the case in a person who from any cause had been teased for a considerable time by an incessant inclination to void his urine. The vessels of the mucous membrane were turgid with blood; but not in the same degree as those of the membranous structures of the kidneys.

A gentleman, 55 years of age, consulted me with Mr. Bagster of Compton Street, Brunswick Square, in December 1834, under the following circumstances:—He complained of an almost incessant inclination to void his urine; of an excruciating pain, referred to the region of the pubes and neck of the bladder, which occurred as soon as the urine was expelled, and then subsided; and also of a most severe pain extending along the whole canal of the urethra. This last symptom was not especially connected with the expulsion of the urine. It was nearly constant, but not quite so, as it occasionally intermitted for twelve hours, or even for a longer period.

The urine was acid, and when voided was slightly turbid, and of an opal colour. When allowed to stand, it deposited some loose flakes, which bore a more near resemblance to coagulated lymph than to

mucus. The clear urine, after this deposit had taken place, was tested by heat, and afterwards by the addition of nitric acid, and proved to be highly albuminous. There was no pain in the loins.

On inquiring into the patient's history, I was informed that in childhood he had voided a small calculus; that he had generally enjoyed good health until the year 1824, when he was affected by a succession of slight febrile attacks, attended with sickness and vomiting, from which, however, he recovered, so as to be apparently quite well afterwards.

In the year 1827 or 1828, and again in the year 1834, he had a similar attack. The last of these continued, with occasional remissions, from September to the beginning of November; and immediately after it had subsided the symptoms of irritation in the bladder and urethra first showed themselves, continuing unabated from this period up to that of my being consulted. After a careful investigation of the case, I gave it as my opinion, that the real seat of the disease was in the kidneys, and that the bladder and urethra were only secondarily affected; and I proposed a plan of treatment accordingly. This was continued without any manifest improvement until the 5th of January 1835, when the patient was suddenly seized with a pain in the neighbourhood of the epigastrium, followed by symptoms of peritoneal inflammation. He was attended by Dr. James Johnson and Mr. Bagster, but their efforts for his relief were unavailing; and he died in about four days after its commencement.

I had the opportunity of examining the body in conjunction with the gentleman who had attended the patient in his last illness. We found the abdomen to contain a yellow fluid resembling a mixture of bile and serum. Coagulated lymph had been effused on different parts of the surface of the peritonæum, but chiefly in the neighbourhood of the duodenum and jejunum, and had produced adhesions which however, being recent, were easily separated. The gall-bladder was attached in this manner to a fold of the jejunum; and on these adhesions being torn through, the bile

was observed to escape from it in a small stream. On laying open the gall-bladder five or six biliary calculi, from the size of a pea to that of a horse-bean, were found in its cavity; and in one spot there was a distinct ulceration of the membrane lining it. This ulceration had extended completely through the peritonæum, covering the gall-bladder, so that it was evident that there must have been a communication between the cavity of that viscus and the general cavity of the abdomen, previous to the formation of the adhesions with the small intestine.

The urethra and the urinary bladder presented no appearance of disease; but the tunics of the bladder were thinner than might have been expected, considering that the patient had for some time suffered from a frequent inclination to make water. The mucous membrane was not more vascular than under ordinary circumstances. The prostate gland was not enlarged; but it might be supposed that its texture was a little firmer than usual.

The right kidney was vascular, and of a somewhat soft and spongy texture; and its investing membrane adhered more closely to the fat of the loins than to the kidney itself. The ureter on this side was unusually small and attenuated. The left kidney was half as large again as usual. The fat of the loins, the investing membrane of the kidney, and the kidney itself, adhered so closely to each other, and were so consolidated, that they could scarcely be separated from each other. In the upper part of this kidney there was a membranous cyst containing about an ounce of a turbid fluid. This cyst appeared at first to have been formed by a dilated infundibulum; but on an accurate examination it was found to have no communication with the pelvis of the kidney. A good deal of earthy matter had been deposited in the membrane forming it, so that in one part it appeared like a shell of bone. In the lower part of the same kidney were two calculi (composed of the oxalate of lime), one as large as a horse-bean, the other smaller but of a jagged and irregular figure. They lay in two separate infundibula, projecting into the pelvis. The left kidney, like the right, was soft and vascular. The left ureter was in a natural state.

What has been stated now seems to afford sufficient evidence as to the existence of symptoms referred to the bladder and urethra in some cases of disease in the kidney. But, with my present experience I am led to this further conclusion, that a very large proportion of the cases which have usually been confounded together under the general appellation of irritable bladder are really of this description; and that in many cases, in which the bladder is actually diseased, it was not so in the first instance, the disease in the bladder being altogether a secondary affection, which would never have existed if there had not been a previous disease in the kidneys.

But nothing is more common than to meet with disease in the kidney in the examination of the body after death, where there had been no complaints as to the bladder and urethra during life; and in many living persons there are indubitable signs of the kidneys being diseased, while the functions of the bladder and urethra are not in the slightest degree disturbed. It cannot be supposed that it is merely from a caprice of nature, that one organ should sometimes sympathise, and sometimes not, with the diseases of another; and the question therefore arises, in what particular cases of renal disease is it that the secondary affections of the bladder are liable to occur?

I have already explained, that where the urine is overloaded with acid, showing itself in the form of lithate of ammonia, or brown or red sand, or where being alkaline it deposits crystals of the triple phosphate of ammonia and magnesia, it acts as a stimulus to the parts with which it comes in contact, and that an irritable state of the bladder is the consequence. But there is no reason to doubt that other unhealthy secretions of urine may produce the same result; and I am much inclined to believe that such is the real explanation of the affection of the bladder in the cases which are now under our consideration. In such of them as have fallen under my observation the urine has been always altered from its healthy condition, and its sensible qualities may be described as follows: —

There is usually a copious secretion, the specific gravity being below the ordinary standard. But there is some variety in this respect; and I have known the specific gravity to be as high as 1·030. When tested with litmus paper, it is generally found to be slightly acid; but occasionally it is alkaline; or it is sometimes alkaline, and sometimes acid; and, as I shall explain hereafter, the disposition in it to become alkaline increases as the disease advances. When first voided the secretion is of a pale yellow colour, opaque and turbid; sometimes having minute flakes of lymph floating in it. On the addition of nitric acid, or an exposure to heat, there is an abundant coagulation of albumen. When allowed to remain at rest there is a deposit of opaque matter, and not unfrequently of pus. The urine is always albuminous, but quite different in appearance from that which is secreted in the cases which were first described by Dr. Bright, and to which the attention of physicians has been of late years so much directed. The albuminous matter seems to be mechanically suspended, and not intimately blended and assimilated with it; as if the kidney were in a state of chronic inflammation, secreting urine from one set of vessels, and serum, or even pus, from others. Such, probably, is the real nature of the disease when once established, whatever it may have been in its origin; and you will find this view of the case to be confirmed by some facts to which I shall draw your attention presently.

The great majority of the patients who are thus affected are of the male sex. Many of them seem to have been originally of a feeble, and what is commonly called a scrofulous, constitution. The disease, however, is by no means confined to persons of this description. It may be the result of a calculus long impacted in the kidney. Not unfrequently it follows an attack of gonorrhœa, though I suspect that it may, for the most part, be traced to the treatment employed, rather than to the gonorrhœa itself. I allude to the injudicious exhibition of large doses of copaivi and cubebs, especially of the latter.

The patient complains of a too frequent inclination to void his

urine; the period during which he can retain it varying from a quarter of an hour to an hour. There is a cutting pain referred to the neck of the bladder and urethra as the urine flows, and remaining for some time afterwards; and there is a constant sense of uneasiness above the pubes. Sometimes there is a dull, but rarely a severe, pain in one or both loins; at other times there is no pain in the loins whatever, or so little, that the patient scarcely thinks of mentioning it until he is questioned on the subject. In a few instances, masses of lymph, of the consistence and appearance of jelly, are found in the urine, which have evidently descended from the kidney. In one case the patient, who for two or three years had had no other symptoms than a too frequent desire to make water, and a deposit of pus in the urine, was suddenly seized with a most severe pain in the groin and testicle, so that I concluded that a renal calculus was making its way down the ureter. Instead of this, however, soon after the pain had suddenly terminated, there was found in the urine a mass of solid substance, resembling fibrine, of a pale brown colour, of a conical shape, smooth everywhere, except at the larger extremity, where it had an irregular and fringed appearance, as if had been broken off from a larger mass. From this time he continued to suffer in the same manner, voiding similar masses of solid substance at various intervals, and in one of these attacks he died. His death took place in the country; and I believe that no examination of the body was made afterwards. From the account which I received, however, I was led to conclude that the immediate cause of death had been the retention of one of these masses of fibrine in the ureter.

As the disease advances, the patient becomes feeble and emaciated; his complexion is sallow, and he is liable to attacks of nausea and even of vomiting, with a constant sense of languor and listlessness, and indisposition to both mental and bodily exertion. The desire to void the urine is incessant, and the sufferings caused by the accumulation of it in the bladder are more severe. As the bodily health becomes impaired, the disposition to secrete alkaline

urine is increased; and this change is the usual precursor of the more urgent symptoms of affection of the bladder which mark the advanced stage of the disease. The urine deposits a large quantity of adhesive alkaline mucus; it is of an offensive ammoniacal odour, scalding the urethra as it flows, and producing a severe and constant pain in the hypogastrium. Even in the origin of the disease blood is sometimes discharged with the urine; but at this later period the disposition to hæmorrhage is increased. In some cases the urine generally is tinged with blood, and at other times there is an evacuation of pure blood, adding greatly to the patient's misery, not only in consequence of the clots becoming lodged in the urethra, and obstructing the passage of the urine, but by increasing the debility of an already weakened frame. The pulse becomes small and frequent, the tongue is dry and brown, or red and glossy, with a disposition to aphthæ; there is coldness of the extremities, and these symptoms usually precede the patient's dissolution. But it is otherwise in some instances, the patient dying almost suddenly even in a less advanced stage of his complaint. Not only in these, but in many other cases of disease of the kidney, it occasionally happens that an accidental circumstance, which, if the patient were in health, would be productive of no more than a temporary derangement of his system, may be sufficient to extinguish life. I have even known a case in which the introduction of a bougie having been followed by a severe rigor, the usual reaction never took place, and the patient died in consequence. It seems probable that in such cases it is the accumulation of some noxious matter in the blood, which ought to have been separated from it by the kidney, that is the immediate cause of death.

I have had several opportunities of examining the morbid appearances after death, where the patient had died in this last stage of the disease, and where the history of the case seemed to indicate that the kidney had been the only part affected in the first instance. One or both kidneys are found enlarged in size; unusually vascular; of a dark red colour; soft and readily torn;

the distinction between the cortical and tubular portions being less distinct than under ordinary circumstances. Interspersed throughout this diseased mass there are sometimes small deposits of a yellow substance, apparently unorganised lymph. The membranous capsule adheres more closely to the surrounding parts than to the kidney itself. Sometimes the kidney and ureter are imbedded in a mass of firm organised lymph, which involves all the neighbouring structures. Frequently there are thin membranous bags of various sizes in the cortical substance containing, not urine, but a serous fluid. Abscesses are found in the kidney of various sizes, some of which may have made their way into the pelvis and infundibula. In one case one kidney was of double its natural size, and full of deposits of cheesy matter, resembling that which is found in scrofulous lymphatic glands, varying in quantity from the bulk of a pea to that of a horse-bean. The other was diseased in the same manner, but to a less extent. Sometimes an offensive mixture of pus and urine is found in the pelvis and ureter. Occasionally, but rarely, there are deposits of phosphate of lime adhering to the mamillary process; more frequently there are similar deposits on the inner surface of the membranous cyst and abscesses. The mucous membrane of the bladder and ureters, in most instances, is everywhere of a dark-red colour, from excessive vascularity, and exhibits the other appearances which have been already described in the history of inflammation of the mucous membrane. In a few cases, however, the appearance of inflammation is only in patches, and where it exists the mucous membrane is partially ulcerated. These ulcers occur more especially about the orifice of the ureter, the lower extremity of which is seen making a small nipple-like projection in the centre. If the patient survives this stage of the disease, the ulceration of the mucous membrane extends until it occupies a large portion of the internal surface of the bladder. Nor are these secondary diseases confined to the bladder. I have seen cases in which abscesses and ulcers of the prostate gland were apparently to be referred to the same source, as I shall explain further in the next lecture.

In concluding this part of the subject, I think it will be worth while to give you the particulars of the following case, which is interesting, not only because it presents a complete history of the disease from its commencement to its termination, but also because it is plain, from the condition of the ureters, that the disease of the bladder was not the result of continuous inflammation extending to it along the mucous membrane of the kidney.

In the year 1822, a woman, at that time 24 years of age, first experienced a slight pain in the loins. Two years afterwards she had an attack of severe pains in the loins, and the urine appeared to be tinged with blood. She was very ill for several weeks, her medical attendant considering the disease to be inflammation of the kidneys. When the more severe symptoms had subsided, the slighter degree of pain in the loins remained as it was before the attack took place. Four years afterwards, she had another attack, which was also supposed to be one of inflammation of the kidneys, but less severe than the former one. At the end of another year, for the first time, she experienced symptoms of the bladder being affected, having a frequent desire to void her urine, and pain in voiding it. In the year 1830, she was admitted into St. George's Hospital, her condition being as follows:—She complained of pain referred to the loins and pubes. She voided her urine frequently, and in small quantities. She had pain in the extremity of the urethra, especially in expelling the last drops of urine. She had little or no disposition for food, was in a state of great debility, and suffered occasionally from rigors. The urine was highly serous. No calculus could be detected in the bladder. Her general health continued to fail, and at the end of April, two months after her admission into the hospital, she died.

On examining the body, tubercles and a few small vomicæ were found in the upper part of each lung.

There were some marks of inflammation of the peritonæum, especially in the pelvis, where a small quantity of coagulated lymph had been effused on its surface.

The glandular structure of the kidneys, especially of the right kidney, was softer and more vascular than in health. Near the pelvis of the right kidney, a small portion of the glandular structure was of a greenish colour, and seemed to be in a state of sphacelus, or approaching to it. The mucous membrane of the pelvis and infundibula was highly inflamed.

The mucous membrane of the upper extremity of the ureters, and of the bladder and lower part of the ureters, bore marks of high inflammation also; but the middle or intermediate portion of the ureters was in a perfectly healthy state.

Treatment of these Cases.

You will easily believe that, in the advanced stage of the complicated disease which I have just described, little is to be done by art for the patient's relief. The exhibition of the decoction of the root of the pareira brava may restrain the secretion of the adhesive mucus, from the inflamed mucous membrane. Large doses of opium may, in some degree, mitigate the patient's sufferings, and the prudent exhibition of wine may for a time uphold his failing powers. But this is all; and the disease will pursue its course to a fatal termination in defiance of all your efforts to arrest its progress. It seems as if when the kidney had been for a considerable time the seat of disease, even though no actual organic change of structure has taken place in it, it were almost incapable of recovery; and, at all events, if one drop of matter be deposited in its substance, this must be regarded as the commencement of a large abscess, and as leading, almost inevitably, to the worst ultimate results.

There are, however, many cases in which the patient may obtain a cure, and there are others in which his symptoms may be much relieved, under a judicious mode of treatment. I conclude that, in such cases, the disease is that which can be designated by no more appropriate name than that of chronic inflammation, not yet sufficiently advanced to have produced any serious change in the condition of the kidney.

If the urine be more than usually loaded with lithic acid, some advantage may be derived from the exhibition of moderate doses of the liquor potassæ, or the bicarbonate of potass. But this is seldom necessary, and alkalies ought to be administered with great caution where there is danger of the urine becoming alkaline, and where this change in the quality of the secretion is likely to be followed by such serious consequences as those which I have described. Whenever the urine is secreted alkaline in the kidneys, or has a tendency to be alkaline, the opposite treatment is indicated, and the mineral acids should be given in larger or smaller doses according to circumstances.

In robust persons, where the disease is but little advanced, and there is much pain in the loins, a moderate quantity of blood may be taken from the loins by cupping. But there can be no greater practical error than to suppose that, because a disease partakes of the inflammatory character, it is therefore to be relieved by blood-letting. Many such diseases are liable to occur in persons of debilitated constitution, and, being once established, have a tendency to increase the debility in which they have originated, being at the same time aggravated instead of being relieved, not only by the loss of blood, but by active depletion in other ways. In some instances, I have known much good to arise, apparently, from blisters applied near the affected loin, or from issues made with caustic, or setons in the same situation. But even these should not be had recourse to without due consideration; and in persons of a delicate habit I am inclined to restrict their use to those cases in which the pain in the loins is considerable, or in which there is a discharge of pus, or of masses of unorganised lymph from the kidney.

For the same reason that depleting remedies are to be used with caution, it is never desirable that the patient should be placed on a very low or abstemious system of diet. He should have animal food daily, with the addition of a moderate quantity of ale or wine. He should, if possible, reside on a dry gravelly soil rather

than in a low and damp situation; or he may derive benefit from a residence at the sea-side.

The uva ursi has a doubtful reputation as a remedy in cases of disease of the bladder, some believing it to be of great efficacy, and others attributing to it no efficacy whatever. My own experience would lead me to suspect that its influence is confined to the cases of which I am now treating, but that in these it may in some instances be employed with much advantage. It must be administered, however in larger doses than those which I find to be in common use. Thus from ʒj. to ʒij. of the extract may be given in pills daily, or from ʒviii. to ʒxvi. of the following infusion, which has appeared to me to be more useful than the extract.

℞ Foliorum uvæ ursi ʒj.
Aquæ distillatæ ferventis ʒxviij.
Macera per horas ij., dein decoque ad ʒxvj. et cola.

But neither the extract nor the infusion produce an immediate improvement; and if the experiment of taking this medicine be begun, the patient must make up his mind to persevere in it for a very considerable time, before he can form an opinion as to the result.

There is, however, another remedy, which, if my observations be correct, is much more to be relied on than the uva ursi, namely, the diosma crenata, or buchu. Of this, also, I am led to believe that its efficacy as a medicine is limited to this particular class of cases, and in these I cannot doubt that I have seen it productive of the most beneficial effects. From ʒiss. to ʒij. of the infusion of the diosma (of the Pharmacopœia) may be given twice or three times daily. The operation of it is slow, like that of the uva ursi, so that it is needless for the patient to take it unless he fully intends to continue to do so for a very long period. I have known persons who, with some brief occasional intermissions, have persevered in its use, slowly, but uniformly mending, even for two or three years. It would appear that the sarsaparilla may sometimes be combined with the diosma with

considerable advantage. So much of a concentrated preparation of the former as is equal to half-a-pint of the decoction, may be taken daily; and the bicarbonate of potash or some mineral acid may be added (if they be required) to the other remedies.

Another remedy, which I have administered with apparent advantage in these cases, is the *tinctura ferri sesquichloridi*. It may be given in doses of ♏ viij. to ♏xx. twice daily, either in any simple vehicle, or in combination with the infusion of the diosma. In the latter case, the tincture may be given for a month or six weeks at a time; and this course may be repeated occasionally, the infusion being still administered in the intervals.

Before I conclude the present Lecture, I feel it to be my duty to caution you against the unnecessary introduction of instruments into the bladder in these cases. It may be right, probably it is so in most cases, in the first instance, to introduce a sound or catheter, so as to ascertain whether there be an obstruction in the urethra, or a calculus in the bladder, or whether the patient retain the power of emptying the bladder by his own efforts. But if these questions be determined in the negative, it is better that you should abstain from the further use of instruments. Every examination gives the patient a good deal of pain at the time, and it often happens that much distress, both local and constitutional, follows, which may not subside for two or three days. Rigors also are more likely to occur after such examinations, than in ordinary cases of urinary disease; and I have already observed, that these are attended with actual danger in all cases in which the powers of the system are exhausted by long-continued disease of the kidney. Where it is thought advisable to examine the urethra and bladder by the introduction of instruments, twenty or thirty minims of tincture of opium or a tumbler of hot brandy and water (I am inclined to believe that the latter is to be preferred), may be administered immediately afterwards. This will rarely fail to prevent the occurrence of a rigor, and no inconvenience, which the laudanum or wine may occasion, can be put in competition with the great advantage arising from their use.

LECTURE VII.

INFLAMMATION OF THE PROSTATE GLAND.

Affections of the prostate gland are met with chiefly in those who are advanced in years. This organ, however, is not altogether exempt from disease in earlier life. In cases of gonorrhœa it not unfrequently happens that the discharge from the urethra suddenly ceases, and that the inflammation leaving the part originally affected attacks the prostate. The peculiar symptoms which occur in the cases to which I allude cannot be well explained in any other way, and it may be observed that they never occur except in the male sex.

The patient observes that the gonorrhœal discharge stains his linen much less than it did before, or that it ceases altogether; and he experiences at the same time a frequent inclination to void his urine, and a difficulty in voiding it. He complains of uneasiness and pain, referred to the neck of the bladder, extending forward in the course of the perineum and urethra, and aggravated on each attempt to make water. In some cases there is a complete retention of urine. The impulse to make water is then violent and irresistible; and it is attended with more suffering than in ordinary cases of retention, on account of the contents of the bladder being pressed with force against the inflamed and tender prostate. There is a sense of fulness in the perineum and rectum; and the prostate is manifestly tender when examined from the rectum with the finger.

Not uncommonly suppuration takes place, and an abscess forms, of which the symptoms, in the first instance, are generally obscure. As the abscess advances, the perineum becomes tender, and there

is a perceptible though slight tumefaction and hardness in some one part of it. The abscess, if left to take its own course, sometimes bursts internally—that is, into the urethra; more frequently it makes its way through the fascia, cellular membrane, and muscles of the perineum, and bursts through the external skin.

These local changes are attended with no small degree of disturbance of the general system. The pulse is frequent, the skin hot, the tongue furred, and the formation of matter is often indicated by rigors.

The first object of the surgeon should be to prevent suppuration. The patient should remain in bed, in the horizontal posture. Blood is to be taken from the loins, or perineum, by cupping; and the cupping should be repeated, or not, according to circumstances. Cupping on the perineum, however, can be performed only by a dexterous cupper; and where such an one cannot be procured, leeches must be applied instead. An active aperient should be exhibited, followed by an opiate in the form of an enema or suppository. The bowels having been freely opened, the patient will often derive the greatest benefit from the use of calomel taken in pills in sufficient quantity to subject him to the mercurial influence. If there be a retention of urine, the gum catheter, without a wire or stilet, may, in almost every instance, be readily passed into the bladder. It is better to use a very small catheter, and to introduce it again, whenever it is required, than to leave it constantly in the urethra and bladder. If there be reason to believe that abscess is formed, you should endeavour to procure an external discharge for the matter, in order to prevent it bursting into the urethra. If such symptoms as I have described exist, and go on for some time increasing, and you discover a fulness and tenderness of the perineum, do not wait for any more certain indication of the abscess; but introduce a lancet, in the direction indicated by the tenderness and swelling. It will often be necessary to pass it quite up to the shoulders, or even to the handle, before you reach the abscess. But you may do this fearlessly. There is no danger of any ill consequences from such a

puncture. If there be abscess, yon will by this proceeding immediately relieve the distress which the patient suffers, at the same time that you prevent further mischief. If, on the other hand, there be no abscess, the puncture does not make the condition of the patient worse than it was before. Indeed, partly from the loss of blood, partly by removing the tension of the soft parts of the perineum, it is generally useful to the patient, even when it does not answer the purpose of allowing the escape of matter.

When an abscess of this kind has been opened, or has burst in the perineum, it generally happens that a portion of the urine flows through it, showing that it communicates with the urethra as well as externally. This prevents it from healing, and in order that the inconvenience should be relieved, a full-sized bougie or catheter should be introduced from time to time, under which treatment the healing will be soon completed.

Abscess of the prostate gland may take place in young men under other circumstances beside those which I have just mentioned.

A man about 30 years of age was received into the hospital, voiding his urine every twenty or thirty minutes, and complaining of an aching pain in the loins; but of no pain anywhere else. The urine deposited a small quantity of yellow puriform sediment. He said that the symptoms had begun two years ago, and that in the commencement of the disease the urine had been tinged with blood. I prescribed the use of an opiate clyster every night; and under this treatment the inclination to make water became less frequent.

About a month after his admission into the hospital, the patient was suddenly seized with symptoms of apoplexy, and he died in the course of a few hours. In the examination of the body, we discovered an abscess of the size of a large walnut, occupying the posterior part of the prostate gland, and extending into the space between the bladder and vasa differentia behind the neck of the bladder. On slitting open that portion of the urethra which passes through the prostate, a large irregular ulcerated orifice was dis-

covered behind the verumontanum, through which the probe passed at once into the cavity of the abscess.

I had the opportunity of observing the same morbid appearances in the post-mortem examination of a patient who died under the care of Dr. Prout and myself, and who had long laboured under symptoms of disease at the neck of the bladder. I conclude that in the following case, also, the seat of the abscess was in the prostate gland.

A gentleman, about 30 years of age, consulted me, complaining that the urine flowed slowly, and with difficulty I introduced a gum catheter, and found a considerable quantity of urine left in the bladder, after he had voided what he could by his own efforts. There was no stricture of the urethra, and the use of the instrument did not relieve the difficulty of making water, so that it was necessary to introduce it two or three times daily. When this plan had been persevered in for three or four days, there took place one evening a severe attack of shivering. The next day it was discovered that the urine deposited a considerable quantity of pus. The patient could now make water and empty his bladder without the assistance of the catheter: however, he was directed not to do so, but to use the catheter for himself every six or eight hours. The urine continued to deposit the same purulent sediment, but the quantity of it gradually diminished, and in the course of two or three weeks it disappeared entirely; but no symptoms being left, the use of the catheter was not considered necessary. I have seen this gentleman several times since, on other occasions, and as far as I know, he has never had any return of the complaint.

In the case which I have mentioned as having been attended by Dr. Prout and myself, in addition to the abscess at the neck of the bladder, there were abscesses and extensive disorganisation of the kidneys. I may here refer you to what I observed as to the coexistence of disease in the kidney and bladder in the last Lecture. We cannot well doubt the existence of this combination in the following case, although the fact was not absolutely proved by dissection.

A young man had symptoms which caused me to suspect the existence of abscess of the prostate. Under these circumstances he was seized with a rigor, with pain in the loins, extending downwards in the course of the ureter; in short, with symptoms like those produced by the passage of a calculus from the kidney into the bladder. These symptoms suddenly ceased, and he voided, not a calculus, but a mass of lymph and pus, and some blood, which came away with the urine. I now was led to believe that I had been mistaken in my notion as to the original seat of the disease, and to suspect that the neck of the bladder had been affected only from sympathy with the kidney; but soon afterwards another abscess presented itself in the perineum, which I opened with a lancet, proving that my original opinion had not been incorrect. This gentleman went into the country, and soon afterwards died labouring under a severe diarrhœa. Unfortunately, the body was not examined after death.

When a patient labours under such symptoms as would lead you to believe that an abscess has formed in the prostate, communicating with the neck of the bladder, you should direct him not only to be as quiet as possible, but to remain altogether in the horizontal posture. You should instruct him in the use of the gum catheter; and he should introduce it for himself whenever he has the desire to void his urine, so that he may always make water by means of the catheter, and not by his own efforts. In some instances I have caused the gum catheter to be constantly retained in the urethra and bladder, until the abscess has healed; but this plan not unfrequently irritates the neck of the bladder; and the occasional introduction of the catheter is, for the most part, to be preferred. In other cases, even this excites irritation, and the catheter must be omitted altogether.

Besides this, you must attend to the state of the patient's general health. There is usually a weak state of the constitution; the patient is probably of a scrofulous habit, and the healing of the abscess may be promoted by the exhibition of the sulphate of quinine, or iron, or other tonics. It has appeared to me, in some

cases, that good has been derived from the internal use of the cubebs pepper. Twenty grains of the powder may be administered three times daily. It seems to act as a gentle stimulus to these parts, probably operating on the disease much in the same way as Ward's paste operates on abscesses, and fistulæ, and ulcers of the rectum.

I have mentioned formerly that an enlargement of the prostate gland sometimes occurs as a consequence of stricture of the urethra, subsiding spontaneously after the stricture is cured. The same thing may happen after gonorrhœa, especially where the patient has neglected his complaint; hunting, or using other violent exercise, before the discharge has ceased. In one case of this kind the prostate was enlarged (apparently) to four or five times its natural size, producing much uneasiness from pressure on the rectum, but not in any degree interfering with the functions of the bladder. The disease subsided, but very gradually; and in the course of three or four years no perceptible enlargement remained.

I shall mention the particulars of another case, in which the patient attributed the disease to an attack of gonorrhœa at a former period, and which is also of some interest on account of its having immediately yielded to the treatment employed.

A gentleman, 31 years of age, consulted me, with Mr. Turner, of King Street, Holborn, under the following circumstances. He complained of pain, referred to the perineum, hypogastrium, and back part of the pelvis, and extending down the thighs. The pains, however, were not very severe. He had a sense of obstruction in the rectum on the passage of the fæces. He was tormented by the desire to void his urine more frequently than is usual; but he had no difficulty in voiding it; he could empty his bladder by his own efforts, and the urine was transparent and healthy. The urethra was free from disease; but the prostate gland, when examined from the rectum, was found to be enlarged to two or

three times its ordinary size. The patient said that the disease had existed in its present form, for three or four years; but he could nevertheless trace its origin to a severe gonorrhœa under which he had laboured ten years ago. He had no other complaints. We prescribed for him two grains of the iodide of potassium to be taken three times daily. This plan was pursued under Mr. Turner's direction for about seven weeks, when I was again consulted. He was now nearly free from pain; voided his urine not more frequently than other persons, and as much as ten ounces at once. The prostate gland was reduced to its natural size. As a matter of precaution I advised that the iodide of potassium should be taken for another fortnight.

Chronic Enlargement of the Prostate Gland.

I have said that the prostate gland is more frequently the seat of disease in old age than it is in youth.

At different periods of human life different changes take place in the condition of the organs of which the system is composed; and none of these are more remarkable than those which show that the individual has entered on that downward course, which is to end in his dissolution.

When the hair becomes grey and scanty, when specks of earthy matter begin to be deposited in the tunics of the arteries, and when a white zone is formed at the margin of the cornea, at this same period the prostate gland usually, I might perhaps say invariably, becomes increased in size. This change in the condition of the prostate gland takes place slowly, and at first imperceptibly, and the term chronic enlargement is not improperly employed to distinguish it from the inflammatory attacks to which this organ is liable in earlier life.

In the post-mortem examination of persons, who die labouring under this disease, we find the prostate sometimes enlarged only in a slight degree; but frequently it is two or three times, and occasionally even ten or fifteen times, its natural size. We also find more or less alteration in its texture. For the most part it

is harder than natural; but, in a few instances, it is the reverse. In some instances, the enlarged prostate retains nearly its natural form; and, under these circumstances, if you lay open the cavity of the bladder, you find the existence of the disease marked only by the appearance of a uniform circular projection surrounding the internal orifice of the urethra. More frequently, however, the form of the prostate is altered, and it no longer presents the appearance of a chestnut placed at the neck of the bladder, and perforated by the urethra. Posteriorly the lateral portions of the prostate are found extending on the outside of the vesiculæ seminales, between the bladder and the rectum. That part of the prostate, also, which is situated between the vasa deferentia and the neck of the bladder, and to which Sir Everard Home has given the name of the third lobe, becomes enlarged also, forming a tumour projecting forward into the cavity of the bladder, behind the inner orifice of the urethra. This tumour varies in size from that of a horse-bean to that of an orange. When small, it is of a conical form, the apex of the cone projecting into the bladder, and the basis being continued into the rest of the prostate. When large, the basis is often the narrowest part, and it swells out so as to have a pyriform figure towards the bladder. In some instances, by the side of that which I have just mentioned, there is another tumour, formed by one of the lateral portions, also projecting into the bladder.

The canal of the urethra, where it passes through the enlarged prostate, is generally flattened; and when the latter is divided transversely, the urethra appears like a slit, rather than like a cylindrical canal. Not unfrequently the enlargement of the prostate so alters the form of the urethra, that instead of pursuing a straight course through the gland, it is inclined first to one side and then to the other. You would expect the urethra to be rendered narrow in consequence of the increased bulk of the parts by which it is surrounded; and so it is in many instances: in others, however, it is actually wider, being dilated into a kind of sinus where it lies in the centre of the prostate. I have known

such a sinus to exist of a sufficient size to contain two or three ounces of fluid. In addition to these changes the natural curve of the urethra, as it approaches the bladder, is increased. It forms a portion of a smaller circle. It also becomes elongated, so that the distance between the orifice on the glans penis and the cavity of the bladder is greater than natural. This is the necessary consequence of the increased size of the prostate; and in this manner as much as an inch or an inch and a half is sometimes added to the length of the urethra.

Malignant diseases of the prostate are of very rare occurrence, and it is certainly a great mistake to apply the term scirrhus to the cases which are now under our consideration. The chronic enlargement of the prostate may be said to be a disease of a peculiar kind having no exact resemblance to what we meet with in any other organ. It may, however, in some respects be compared to the chronic enlargement of the thyroid gland, known by the name of bronchocele. Like the latter, it is generally slow in its progress; and frequently after having reached a certain point, if proper treatment be employed, it remains almost stationary for many years. It is on the whole a rare occurrence for it to terminate in ulceration or abscess; and the symptoms to which it gives rise are, with a few exceptions, to be referred to the influence which the disease exercises over the functions of the parts in the neighbourhood.

Symptoms of the Chronic Enlargement of the Prostate Gland.

There are but few individuals who, in the latter period of life, do not suffer some degree of inconvenience in consequence of the enlarged state of the prostate. The bladder becomes irritable, and there is a more frequent inclination to void the urine than under ordinary circumstances: the urine being at the same time ejected in a slower stream. These symptoms come on very gradually, and for a considerable time attract but little of the patient's attention. A sudden and violent aggravation of them may, however, take place in any period. In consequence of

exposure to damp and cold, or some regularity as to diet, and, very frequently, as a result of venereal excitement at a time when the sexual powers are beginning to decline, there is an increased determination of blood to the prostate, which was before enlarged, causing it to become still further increased in size. The expulsion of the urine then becomes more difficult than it was before, and soon is prevented altogether. There is, in short, a complete retention of urine.

The symptoms of retention of urine, from enlargement of the prostate, are not very different from those which occur where the retention is the consequence of stricture of the urethra, but the termination is different. I never saw a case in which, under these circumstances, the bladder had given way, as sometimes happens where there is a retention from stricture; but I am informed that such a case has occurred, and that the bladder, ruptured at its fundus, is preserved in the Museum of St. Bartholomew's Hospital. It is evident that the urethra itself cannot be ruptured, as the urine does not even enter it, the obstruction being altogether posterior to it. But the patient cannot survive a retention of urine from this cause, any more than he can survive a retention of urine from other causes, beyond a certain period of time. The powers of his nervous system become exhausted: there is a cessation of local suffering; the tongue becomes dry and black, coma supervenes, and the symptoms terminate in death. Mr. Travers has informed me of two cases of long-continued retention in consequence of enlargement of the prostate which fell under his observation, in each of which the mucous membrane was converted into a slough, and was found, after death, lying loose in the cavity of the bladder.

The prostate being once enlarged, it is evident that a very small addition to its bulk may be sufficient, under certain circumstances, to prevent the expulsion of urine from the bladder. Hence it is, that no individual who labours under this disease can be regarded at any time as being at any time free from the danger of a complete retention of urine. This, however, where surgical

assistance can be procured, and proper treatment is employed, is for the most part only a passing evil. The patient is relieved by the judicious administration of art, and a considerable time may elapse before he experiences another similar attack.

But he is liable to other evils, which, although less formidable in appearance, and more insidious and gradual in their progress, lead, if neglected, to a no less fatal result. As the disease advances, the urine is ejected in so slow a stream that it drops perpendicularly downwards from the orifice of the urethra. It is voided at short intervals—every hour, or half hour, or every twenty minutes; or, perhaps, it dribbles away involuntarily. This latter symptom occurs especially when the patient is in bed, and is a source of great anxiety and distress. At the same time, a slight degree of pain is experienced in the course of the urethra, and in the glans penis. At first the urine is clear, in no way different from that of a healthy person; then a few small threads or flocculi are seen floating in it; and afterwards it becomes slightly turbid and opaque. If, under these circumstances, you introduce the catheter into the bladder, you find a simple explanation of all these symptoms. Although the patient is continually voiding his urine, and gets rid of the usual quantity in the twenty-four hours, his bladder is never empty. A certain portion of urine is always stagnant in it, the quantity of the residuum varying, in ordinary cases, from one or two ounces to a pint. Occasionally the quantity retained is much larger. An elderly gentleman consulted me on account of some difficulty in voiding his urine, which seemed to arise from an enlargement of his prostate gland. At the same time I observed that there was an enlargement of the abdomen, not from tympanitis, but apparently from a collection of fluid in it. On introducing a catheter I drew off no less than $11\frac{1}{2}$ pints (230 ounces) of transparent and apparently healthy urine.

Now, I do not mean to assert that all persons, in whom the prostate is enlarged, lose the power of emptying the bladder, but I certainly believe that this happens, sooner or later, in the greater number of instances; and you will soon learn how im-

portant is the knowledge of this fact, whether it be viewed in connection with pathological science or practical surgery.

When the prostate gland is much enlarged, the tumour projecting into the bladder irritates the mucous membrane, which becomes in consequence affected with chronic inflammation. The same effect is produced, and to a still greater extent, by the constantly distended state of the bladder. The inflamed surface secretes a thick, tenacious mucus, having an offensive ammoniacal odour, which is in itself a source of irritation, aggravating the inflammation in which it had its origin. I have already explained to you what are the symptoms and the consequences of chronic inflammation of the mucous membrane of the bladder, and you will easily understand how much this complication must add to the patient's sufferings and danger. Chronic inflammation of the mucous membrane of the bladder is, indeed, one of the most frequent causes of death in neglected cases of enlargement of the prostate, and where it does not operate directly, it frequently operates indirectly, so as to produce a fatal result. Small earthy deposits are formed in the alkaline mucus; many of which, instead of being expelled by the urethra, fall to the bottom of the residuary urine; these, increasing in size, and ultimately becoming cemented together, lay the certain foundation of a calculus in the bladder. I shall give you a more particular history of vesical calculi, produced under these peculiar circumstances, in a future Lecture.

In all cases of enlarged prostate, in which the disease is allowed to take its own course, the muscular tunic of the bladder becomes increased in thickness and strength. The reason of this is obvious.

The bladder has been called on to make unusual efforts; and all muscles, under these circumstances, acquire an increase of size. The mucous membrane frequently becomes protruded through the triangular spaces between the muscular fibres forming pouches or cysts, similar to those which I have already mentioned as occurring in neglected cases of stricture of the urethra. These cysts are generally small, but occasionally they attain a large size;

and it is remarkable that they sometimes contain what appears to be pure pus, while the bladder, with which they communicate, contains only urine. An old gentleman consulted me, labouring under disease of the prostate gland. He had a frequent inclination to void his urine; and on introducing the catheter, immediately after he had voided it, about three or four ounces of urine were found to have been left in the bladder. But what he chiefly complained of was an uneasy sensation in the rectum. He gave it the name of a worming sensation, and said it was as if a worm were crawling between the bowel and the bladder. One day, after drawing off the usual quantity of nearly clear urine, on introducing the catheter a little further, to my surprise, half a pint of pus came away. The same thing occurred two or three times afterwards. At first I was led to believe that the catheter had entered the cavity of a common abscess. But it was not long before I had the opportunity of ascertaining the real nature of the case. The patient died; and on examining the body, the prostate gland was found a good deal enlarged; there were three cysts, of various sizes, communicating with the bladder, and formed in the manner which I have just described. The largest of these was situated between the bladder and the rectum, and contained half a pint of pus. There was no ulcerated surface; and it appeared that the pus must have been secreted by the mucous membrane of which the cyst was composed.

It is not uncommon, on making a section of an enlarged prostate gland, to find in its substance several small collections of a muco-purulent fluid, having the appearance of pus mixed with the natural secretion of the gland. Sometimes there is a distinct abscess, which attains a very considerable size, presenting itself at last, in one or another situation, according to circumstances. A gentleman who had laboured under enlargement of the prostate for many years complained of uneasy sensations about the hips, extending down the thighs. At the same time his pulse was somewhat accelerated, and he was subject to attacks of chilliness, not amounting to rigors. He was in the habit of introducing the

catheter; and he observed that it entered the neck of the bladder with some degree of difficulty, as if the urethra, where it passes through the prostate, was contracted in its diameter. These symptoms had existed for many months, when at last, while he was in the act of using the catheter, an abscess burst, and several ounces of pure pus were discharged by the urethra. I had another patient who complained of similar sensations, and also of an increased difficulty in introducing the catheter, so that I was led to believe that an abscess had formed in the prostate. When he had continued in this state for many weeks, an abscess burst into the rectum, discharging a considerable quantity of pus, and this was followed by the relief of all the symptoms. In a third case, the patient, not content with leading the quiet life which I had recommended, returned to his favourite pursuit of hunting. The formation of an abscess in the prostate was the consequence. When I was again consulted, the abscess had presented itself in the perineum. I opened it with a lancet, and some ounces of pus escaped. However, the whole of its contents were not freely discharged through the artificial opening, and the abscess afterwards burst into the urethra. For a long time matter continued to flow in large quantity by the orifice of the perineum, and by the urethra also. At last the quantity of discharge underwent a sensible but gradual diminution. It had not, however, entirely subsided when I last saw the patient, which was more than two years from the period of the abscess having been opened.

I have said that it is not uncommon to find on dissection that suppuration had begun to take place in the substance of the prostate, probably in its excreting ducts; and I conclude that such is the origin of the abscess in the greater number of cases in which an abscess is formed. It is, however, not improbable that in some instances suppuration may take place in the cellular membrane external to an enlarged prostate, as an abscess connected with a diseased lymphatic gland is often situated, not in the substance of the gland, but on its surface, in the cellular membrane between it and the skin.

Ulceration of the surface of that portion of the prostate which projects into the bladder occurs occasionally in the very advanced stage of the disease. An elderly gentleman who laboured under disease of the prostate gland, and was in consequence unable to empty his bladder by his own efforts, was in the habit of relieving himself by the introduction of the catheter twice or three times daily. He had gone on in this way for a year and a half, when he began to experience great uneasiness as soon as a very few ounces of urine were collected in the bladder, and was, in consequence, under the necessity of introducing the catheter four or five times in the twenty-four hours; at the same time that the urine became dark-coloured, as if from a small admixture of blood. These symptoms gradually increased, until at last the accumulation of even two or three ounces of urine produced violent spasms of the bladder and abdominal muscles, attended with such agonising pain that he could not forbear screaming. The introduction of the catheter relieved him for a time; but in the course of one or two hours the pain and spasms returned as severe as before, and continued until the catheter was again had recourse to. He remained in this state nearly three weeks, and at the end of that period died, as if exhausted by excessive suffering. On examining the body after death the prostate gland was found much enlarged. The posterior middle portion of the prostate projected into the bladder, forming a tumour as large as a walnut, and one of the lateral portions projected in the same manner of a still larger size. The surface of each of these tumours was in a state of ulceration. The mucous membrane of the bladder was almost of a black colour, in consequence of its vessels being very much loaded with blood. In another patient, in whom symptoms of the same kind, but less in degree, had existed for more than a year before the disease terminated in death, the prostate was found to be ten or twelve times its natural size, making a large circular projection into the bladder, round the internal orifice of the urethra. Nearly the whole of this portion was superficially ulcerated, and in some places the ulcerated surface was incrusted with a thin layer of coagulated lymph.

A prostate gland which is extensively ulcerated is liable to bleed; but this may be the case also with a prostate which is not ulcerated, or which is ulcerated only to a small extent. Hæmorrhage may, in fact, take place from an enlarged prostate as from any other tumour. Generally, the hæmorrhage is small in quantity; but sometimes it is abundant and alarming. A gentleman laboured under disease of the prostate. He was in the habit of introducing the gum catheter himself. One evening he observed that blood flowed with the urine. In the course of the night he called me up, and I found him with the bladder enormously distended, prominent in the abdomen as high as the navel, and blood still flowing from the urethra. I introduced a large catheter, but no urine escaped. The bladder was distended, not with urine, but with blood. I directed the patient to lose blood by cupping in the loins, and to remain quiet; and, under this treatment, the hæmorrhage ceased; not, however, until a very large quantity of blood had been lost. The catheter was afterwards introduced three or four times daily. The blood by degrees became dissolved in the urine, and, after two or three weeks, the latter was as clear as it had been before the attack of hæmorrhage took place. But the pulse was frequent, the skin hot, the tongue dry and brown, and the patient survived the hæmorrhage only a month. In the post-mortem examination, I found the mucous membrane of the bladder extensively inflamed; a large tumour of the prostate projected into the bladder; and it appeared to me that I could discern the exact spot in which the vessels of the tumour had given way, and from which the hæmorrhage had proceeded. I have seen many other cases of hæmorrhage from the prostate. I had one patient, in particular, who had two attacks of hæmorrhage even to a greater extent than in the case which I have just related, from both of which, however, he recovered, under the treatment which I shall describe hereafter.

I have already explained in what manner the bladder suffers in consequence of enlargement of the prostate gland. The kidneys suffer also, and it is the affection of these organs which principally

baffles our skill, and renders vain all our efforts for the patient's relief, in neglected cases of this description.

In a former lecture I have stated, that disease of the kidney is a frequent consequence of a neglected stricture of the urethra. The renal affections which arise from this cause are very similar to those which arise from disease of the prostate. The same description will apply to both orders of cases; and it is for this reason that I only briefly alluded to the subject as connected with disease of the urethra, referring you to the present lecture for further information on it.

These secondary renal affections are various.

1. In some cases the secretion of urine is considerably augmented. There is a very large flow of urine of a pale straw colour, and this may take place without any considerable alteration in the structure of the kidneys that we can discover on dissection. In one instance, in which the urine had been such as I have described for some years before the patient died, both kidneys were found of a pale colour, and the glandular structure of one of them was much diminished in bulk, the pelvis being at the same time considerably dilated. In other respects the appearance of these organs was the same as under ordinary circumstances. I have mentioned the case of a gentleman labouring under an enlargement of the prostate gland, from whose bladder I drew off 230 ounces of urine. On the following day I drew off 160 ounces, and the same on the day afterwards; and it was not until the catheter had been for some days introduced twice daily, that the secretion of urine was reduced to the ordinary standard.

2. There are other cases, in which the secretion of urine is much diminished in quantity or wholly suppressed. My attention was first called to this fact by the following case, which came under my observation many years ago. A man, who was not much past the middle period of life, but who was old in constitution, had symptoms of enlargement of the prostate gland for two years or more before I saw him. At this time he was harassed by an incessant desire to void his urine. But the quantity which he

voided at one time was very small, so that the whole amount of what was discharged in twenty-four hours did not exceed half a pint. He complained also of pain in the loins, extending across the abdomen. He was subject to occasional attacks of chilliness, but his skin was usually hot and dry, and he had a frequent pulse. On introducing a catheter into the bladder, I drew off half a pint of urine, although the patient had made water immediately before the operation. The introduction of the catheter was repeated twice daily; and under this treatment the quantity of urine drawn off gradually diminished; so that, at the end of a fortnight, he was enabled to empty his bladder by his own efforts. As the quantity of urine retained in the bladder became smaller, so the secretion became more abundant, until it amounted to two pints or more in the course of the day and night. Under these circumstances the patient returned to his home in the country, and I have had no opportunity of learning in what manner the case terminated.

I attended a gentleman, about 70 years of age, with disease in the prostate. I had instructed him in using the catheter for himself, and he drew off his urine regularly. Some months after I first saw him, he observed that he drew off less urine than usual; and that the whole quantity of urine secreted in the day and night was much diminished. There was no distension of the bladder. The catheter entered the bladder readily, but drew off only a very small quantity of urine. At last the secretion of urine was reduced to three or four ounces daily, and I believe to less. Now another order of symptoms began to show themselves. The legs became œdematous: this was followed by difficulty of breathing; the patient was almost suffocated, except when his shoulders were very much raised by several pillows placed beneath them. Then he became drowsy; afterwards comatose, with dilated pupils. There were all the symptoms of effusion of fluid into the chest and ventricles of the brain; and with these symptoms he died. I have no written notes of the case; but if my recollection be accurate, not above ten days or a fortnight elapsed from the time

when the diminution of the secretion of urine was first observed to the day of the patient's death. Unfortunately, the relations would not permit the body to be examined.

I was consulted concerning another case, which may throw some light on the one which I have just related, in conjunction with my friend Mr. Stanley. We had some difficulty at first in determining whether there was actually a suppression of the secretion of urine in the kidneys, or a retention of it in the bladder; and this difficulty was increased by the circumstance of the patient being unusually corpulent; so that, even if the bladder had been a good deal distended, we should have been scarcely able to perceive the usual prominence above the pubes. At last, however, we satisfied ourselves that the catheter drew off no urine, because there was none in the bladder. The patient died, and Mr. Stanley examined the body. He found a growth of medullary fungus immediately behind the internal orifice of the urethra, projecting into the bladder, and extending to the orifices of the ureters. It seemed that this disease, at the termination of the ureters, had impeded the flow of urine into the bladder from the kidneys, both ureters being much enlarged, and distended with urine through their whole extent. The kidneys were very soft and vascular, but contained no large accumulation of urine.

As such cases are not generally noted by surgical writers, I shall not think that I occupy your time unnecessarily in mentioning the particulars of another, which, allowance being made for the difference of the original disease, is similar to those which I have just described, and will serve to illustrate further the influence which an obstruction of the ureters exercises over the functions of the kidneys.

I was desired to visit a gentleman, between 40 and 50 years of age, who was represented to me as having been long troubled with a stricture of the urethra, and as labouring at this time under a retention of urine in the bladder. On introducing a small catheter, I discovered an obstruction in the membranous portion of the urethra, but with some difficulty I made the instrument enter the bladder. The patient had voided no urine for the two or three

previous days, nevertheless not more than a few drops were drawn off by the catheter. The operation was repeated two or three times afterwards, and with the same result. At this time the patient was perfectly sensible, and gave Sir Henry Halford, Dr. Somerville, and myself a distinct history of his complaints. In the course of the next twenty-four hours, however, his mind began to wander, and at the end of three days more he died comatose.

On examining the body, we discovered a very narrow gristly contraction of the urethra, which was evidently a disease of long standing. The urethra behind the contraction was much dilated. The whole of the soft parts behind the stricture, surrounding the urethra, prostate gland, and bladder as far back as the ureters, were much thickened, agglutinated, and indurated apparently from the effusion of lymph at some former period, which had become organised. This change from the natural condition was greatest where the right ureter enters the bladder, and the orifice of this canal was in consequence so much contracted that scarcely the smallest probe could be introduced into it. The whole of the right ureter, above the contraction, was dilated to the size of the small intestine, the mucous membrane being thicker than under ordinary circumstances, and the inner surface bearing marks of slight inflammation. The orifice of the left ureter was also contracted; but in a less degree than that of the right; and the ureter itself was dilated to two or three times its ordinary size.

Both kidneys were unusually vascular, and of a soft consistence. In the right kidney there were two cysts containing serum, not communicating with the infundibula. A small quantity of discoloured fluid was found in the pelvis; but there were no traces of urine either in the kidneys or ureters or bladder. The vesiculæ seminales were involved in the mass of organised lymph which surrounded the neck of the bladder, and converted into a gristly mass, with scarcely any remains of their natural structure. The ventricles of the brain contained an ounce and a half of serous fluid; and about four ounces of fluid were found in the cavity of each pleura.

3. In cases of diseased prostate gland, as in all other cases in which there has been for a long time a considerable impediment to the flow of urine from the bladder, the ureters are liable to become dilated, the pelvis of the kidneys and infundibula being dilated afterwards. I shall describe this peculiar change in the structure of the kidney more at length when I call your attention to the subject of renal calculi.

4. In other cases, both of stricture of the urethra and of enlargement of the prostate gland, the kidneys become diseased in consequence of inflammation which had begun in the mucous membrane of the bladder, extending upwards to those organs along the ureters. The morbid appearances, which the kidneys present under these circumstances, have been already described in the lecture on diseases of the bladder.

5. But it is not common in cases of long-continued obstruction to the flow of urine, whether it be the consequence of stricture of the urethra, or of enlargement of the prostate gland, for the kidneys to exhibit on dissection appearances of disease, although the membrane of the bladder and ureters is but little altered from its natural condition. These appearances are such as chronic inflammation might be expected to produce, where it had not been preceded by inflammation extending up the mucous membrane, and they do not in any material degree differ from those which I described in the fifth lecture, when I drew your attention to that peculiar class of cases in which there are symptoms of irritable bladder arising from disease in the kidneys.

In all the cases which have been just enumerated the ureters are affected in the same manner, being in a greater or less degree dilated, but one generally more than the other; while the effects produced on the kidneys vary according to circumstances. Thus where the obstruction to the flow of urine is of such a nature as to operate directly on the ureters, the result is a complete suppression of the urinary secretion; but where the cause of obstruction is more remote from the kidneys, the bladder, which is a dilatable organ, being interposed between them, the result is a gradual pro-

duction of a disease of the kidneys, which, if not inflammatory in the beginning, ultimately assumes that character, running the ordinary course of chronic inflammation afterwards.

Where the disease of the kidneys has been preceded by inflammation of the mucous membrane of the bladder and ureters, the adhesive alkaline mucus which it contains forms the predominant character of the urine. But in the other class of cases, the urine is voided turbid, with small flakes of lymph floating in it. It exhibits abundant indications of the presence of albumen on being tested with nitric acid, or heat, and it sometimes deposits pus. In all cases, as the disease in the kidneys makes progress, it gives origin to an order of symptoms quite different from those which mark the early stage of the disease of the prostate gland, and which I need only briefly enumerate, as they very nearly correspond to those which I have already described in the concluding part of the last lecture. The patient complains of an uneasy sensation in the loins, which at last amounts to considerable pain. Often he feels as if the back required support, and places a cushion behind him for that purpose. Then there is pain extending across the anterior part of the abdomen above the pubes, and sometimes pain, and even chronic inflammation and enlargement, of one of the testicles. By degrees the local disease affects the general system. The patient is observed to be languid and listless; he dislikes exertion, and scarcely pays any attention to things which he would formerly have regarded as objects of the greatest interest. The pulse becomes feeble; the hands and feet are cold; the stomach refuses food; there is an incessant nausea and sickness: one or two rigors probably occur, which are followed by still more marked symptoms of debility, which gradually become aggravated, until they terminate in death.

Besides the more manifest and important consequences of the chronic enlargement of the prostate gland, which I have already described, and which are to be attributed to the connection with the part diseased with the urinary organs, there are others less dangerous, but sufficiently distressing, which arise from the con-

tiguity of the prostate to the rectum. When this gland is only slightly enlarged, it produces no inconvenient pressure on that bowel; but when the enlargement is considerable, there is a constant sense of weight and bearing down, and the patient has a feeling which leads him to think that he has occasion to evacuate his fæces, although the rectum is empty. I attended an old gentleman who suffered from this kind of tenesmus for some years before he died, and to such an extent as to be rendered quite unfit for living in society. Slighter cases of the kind are not of unfrequent occurrence. The patient usually attributes the sensations which he experiences to internal piles; and, indeed, this last-mentioned disease is often met with in those who labour under enlargement of the prostate, being probably produced by the pressure of the tumour on the larger hæmorrhoidal veins. I have already mentioned a case in which an abscess of the prostate gland burst into the rectum. In this instance the abscess formed a second time and again made its way into the bowel; after which it soon healed, and the patient had never any further inconvenience from it.

LECTURE VIII.

TREATMENT OF CHRONIC ENLARGEMENT OF THE PROSTATE GLAND.

If you bear in mind that the chronic enlargement of the prostate gland to which I called your attention in the last lecture, is not an accidental disease, but one of a series of natural changes which the system undergoes after the middle period of life, you will not be surprised to find that it is but little under the dominion of art. When from any cause the vessels of the prostate are more than usually turgid with blood, the quantity of blood which they contain may be diminished, and thus a reduction of size, to a certain extent, may be effected. It is with this view that we recommend topical blood-letting, the exhibition of gentle purgatives, a moderate diet, and, above all, perfect rest in the horizontal posture. But we are not acquainted with any method of treatment which is capable of restoring the gland to its original condition. I need not occupy your attention with a description of all the experiments which I have known to be made with a view to this result, as it would be only to give you a history of their failure. As, however, I have already referred to a case of enlargement of the prostate occurring in early life, in which great advantage seemed to arise from the exhibition of the iodide of potassium, it is right that I should mention that no experience which I have had would lead me to believe that this medicine is useful in cases of the chronic enlargement of that gland occurring in older persons.

Nevertheless, in these cases, much may be done by means of proper surgical treatment. The prostate gland of a man advanced in life cannot be rendered like that of a young man, any more than his grey hairs can be converted into black; but the

train of evils which the enlarged prostate produces by its influence on the urinary organs may be, in some instances, altogether prevented, and in others very much diminished, so as to remove the patient from a state of extreme, and even immediate, danger to one of comparative security.

In considering the treatment by means of which this object is to be attained, we will suppose, first, that you are called to a patient labouring under a complete retention of urine in the bladder.

The treatment of retention of urine from diseased prostate is one of the most important subjects in surgery. The patient suffers miserably; his life is at stake; he lives or dies according to the skill which you are able to exercise in his favour. The case is altogether different from one of retention of urine from stricture. Bougies are of no service; even if you pass one into the bladder, no urine follows; the parts collapse and close as the bougie is withdrawn.

Neither is laudanum useful in these cases. Here is no spasm for laudanum to relieve. If it produces any sensible effect, it is that it makes the patient less sensible of pain; it makes him think himself better than he really is. It deceives him and his friends for a time, but it does nothing towards curing the retention.

When the retention of urine has taken place suddenly, in consequence of a sudden addition to the bulk of the prostate, the patient may derive advantage from losing blood. He may be bled in the arm, or cupped in the loins; and I have known this in a few cases to be of itself sufficient to enable him to make water. But in the very great majority of cases the retention can be relieved only by the use of the catheter.

I rarely use any but the elastic gum catheter. It gives you rather more trouble to learn the use of the gum catheter, and to become dexterous in the management of it, than it does to learn the use of the silver catheter. When, however, you have once become familiar with the gum catheter, you will generally prefer it to the other; and there is always this advantage in it, that

when you have succeeded in introducing it into the bladder, it may, if necessary, be allowed to remain there. A gum catheter may be retained in the urethra and bladder with very little inconvenience to the patient, which is not the case with a silver catheter.

As Sir Everard Home has observed, the gum catheter may be used in two ways; without a wire or stilet, when it is a flexible instrument; or mounted on an iron stilet, in which case it is inflexible. You should be provided with a number of gum catheters, mounted not on small flexible straight wires, like those usually sold by the instrument-makers, but on strong iron stilets, having the curve of a silver catheter. The stilets which belong to the larger gum catheters should have flattened iron handles, resembling that of a common sound. Let your gum catheters be kept thus prepared for a considerable time before they are wanted for use. They will then become fixed in the proper curvature. With the stilet such a catheter is as inflexible as if it were made of silver, without it, it is capable of retaining its shape to a certain extent, still being flexible.

I always begin with passing such an instrument as this first. If the gum catheter without the stilet will enter the bladder, it is so much the better. It gives the patient no pain; it is incapable of lacerating the urethra, or producing hæmorrhage; it may do all that is required; and it can do no harm even in a rough hand. If you fail in introducing it, the failure will not make it more difficult to pass another instrument afterwards. In difficult cases, indeed, the gum catheter without the stilet will not succeed. You must then use your gum catheter mounted in the way which I have already explained.

You ought not to use a catheter so large as to give pain; but for the most part you will find one which is large enough to fill the urethra, without stretching it, to be more easy of introduction than a smaller one. A very small catheter approaches to a pointed instrument, and the extremity of it is liable to become entangled in the tumour of the prostate. The stilet ought to be considerably

curved. The reason of this is obvious. The tumour which projects into the bladder, and which affords the principal obstruction to the catheter, is situated at the posterior part of the inner orifice of the urethra. A catheter which is slightly curved comes directly in contact with this tumour. In a catheter which is much curved, the point is directed forward towards the pubes, and it avoids the obstruction behind. Always bear in mind, in introducing the catheter, that it is to be used with a light hand. It should be held as it were, loosely in the fingers. It will then, in great measure, find its own way, in that direction in which there is the least resistance. If you grasp it firmly, it can go only where you direct it, and it is liable to puncture and lacerate the membranes of the urethra, and the substance of the prostate, and to make a false passage, instead of entering the bladder.

I generally find that I introduce the catheter best by keeping the handle of it at first close to the left groin of the patient. I pass it as far as possible in this position; then I bring the handle forwards, nearly at a right angle to the pubes, and not elevating it towards the patient's navel. The next thing is to depress the handle, which is to be done gently and slowly, by placing a single finger on it, and pressing it downwards towards the space between the thighs.

In depressing the handle, you generally find the point of the catheter slide into the bladder. Sometimes, however, this does not happen until you withdraw the stilet; and, in the act of doing this, the introduction of the catheter is completed.

Other artifices are necessary, in difficult cases, to enable the catheter to reach the bladder. It may be useful to bend the point forward as it approaches the prostate, either by means of the finger in the rectum, or by pressure made on the perineum. In many instances, the introduction of the catheter will be best accomplished by taking care, while you depress the handle, to keep the concave surface closely pressed against the arch of the pubes, so that it may turn round it as a centre.

But it is impossible to explain to you in words all the minute

circumstances which practice and experience will teach you, and on which your success in this manual operation will very much depend.

In some cases of diseased prostate, the urethra becomes very irritable, and liable to spasm at the membranous part. This is observed especially where several rude attempts to introduce the catheter have been made before you have been called to the patient. Here the gum catheter on an iron stilet is certain to bring on spasm, unless it be handled with the greatest dexterity and gentleness; and sometimes it will induce spasm in spite of all your care; so that you cannot make it pass even to the neck of the bladder. But a gum catheter without a wire, being a softer instrument, is not very likely to produce the same effect; and I have frequently found the following method to be successful:—I have passed the gum catheter as far as it could be made to pass without the stilet; it has probably stopped at the neck of the bladder, that is, at the tumour of the prostate; I have then introduced the stilet into the catheter without withdrawing the latter from the urethra; and thus having made the catheter, without the stilet, pass through the part which is the seat of the spasm, I have been enabled afterwards, by employing the stilet, to direct the point over the tumour of the prostate into the bladder.

I cannot too strongly impress on your minds the necessity of gentle manipulation in all these operations. To attempt to force the catheter into the bladder is an almost certain method of causing it to penetrate into parts which it ought not to enter, and thus adds greatly to the difficulty of introducing it into the bladder afterwards. Besides, such rude treatment lays the foundation of much subsequent mischief, in the shape of abscesses in deep-seated parts, from whence the matter collected cannot find a ready exit, and which, sooner or later, destroy the life of the patient. Such abscesses are not confined to the substance of the prostate gland, or its immediate neighbourhood. I was consulted by a gentleman who had suffered from retention of urine from an enlargement of the prostate some months previously; the catheter

having been, as I understood, introduced with considerable difficulty. From that time, whenever a few ounces of urine were collected in the bladder, he had complained of a most severe pain, referred nearly to the situation of the entrance of the left ureter. The patient ultimately died; and on examining the body after death I found a false passage extending from the urethra behind the prostate gland into an abscess between the bladder and rectum, and at the spot to which the pain had been referred.

When the catheter has entered the bladder, and the urine is evacuated, you must pursue one of two courses: either allowing it to remain in the urethra and bladder, secured by a proper bandage, and with a peg in the orifice, so that the patient may relieve himself whenever he has a desire to void his urine; or withdrawing it, and reintroducing it as soon as the bladder becomes again distended. Now, I do not mean to lay it down absolutely as a rule that you should allow the catheter to remain, but I am certain that it is prudent to do so in the great majority of cases. If you remove it, so abundant is the flow of urine which immediately takes place from the kidneys, that you will find the bladder again distended, and requiring the reintroduction of the catheter within five or six, perhaps even within three or four, hours. It will be necessary to use the catheter again, after another short interval; and it will not unfrequently happen, although there has been no difficulty in the first introduction of it, that there is considerable difficulty afterwards.

You avoid all this by leaving the catheter in the bladder; and there is another advantage in this mode of proceeding. The prostate gland is kept in a state of more complete repose, and in one much more favourable to recovery, so far as recovery can take place, than it would be in, if irritated by repeated introductions of the instrument.

After the catheter has remained in the urethra for some days, you may withdraw it; and if the patient is now able to empty his bladder by his own efforts, it may be laid aside altogether; otherwise, it must be regularly introduced once or twice in a day, or

oftener, according to circumstances. Where the enlargement of the prostate and retention of urine have come on suddenly, the patient generally regains the power of emptying the bladder in the course of three or four weeks, and sometimes much sooner; but where the disease has come on gradually, he never regains it completely. In the former case, he may be liable to a recurrence of the retention of urine, at longer or shorter intervals; but in the latter, he is more or less of an invalid ever afterwards.

Before we quit this subject of retention of urine from an enlargement of the prostate, there is, however, another point to be considered. You will *very rarely* fail, by dexterous management, to introduce the catheter; but you *may* fail, nevertheless, in some instances. What is to be done under these circumstances? Are you to puncture the bladder? and if so, in what situation? It will be of no service here to do what some recommend in cases of retention of urine from stricture; namely, to make an opening into the urethra, beneath the pubes. The size of the prostate renders the case unfavourable for the puncture from the perineum, or the rectum. You may puncture the bladder above the pubes; or you may proceed thus:—When all your efforts to introduce the catheter have been unavailing; when you feel the point pressing against the tumour of the prostate, and unable to pass over it; apply some force to the instrument at the same time that you depress the handle. It will generally penetrate through the prostate, enter the bladder by an artificial opening, and relieve the patient; and of course will continue to relieve him, if you allow it to remain in the bladder.

This mode of proceeding has been strongly recommended by some very good surgeons, and I am not aware that it is attended with danger, although it may not be without its disadvantages. There is reason to believe, that in some cases in which this has been done, the proper internal orifice of the urethra has become so closed that the patient never could void a drop of urine by his own efforts, being compelled to rely wholly on the use of the catheter ever after. Sir Everard Home has published the history of a case

of this kind which was attended by Mr. Hunter and himself. You may see the bladder of this patient, with the perforation of the prostate through which the catheter used to be introduced, preserved in the Museum of the College of Surgeons. The inconvenience which I have now described does not, however, exist in every instance. An old gentleman, the only patient indeed in whom I ever purposely perforated the prostate when suffering from a retention of urine, ultimately regained the power of making water, so as to be able to dispense entirely with the use of the catheter.

Let us now suppose a case in which a patient consults you, labouring under symptoms that indicate a partial retention of urine in the bladder. He is unable to empty the bladder by his own efforts. You then are to introduce the catheter, and empty it artificially. The remedy seems to be very obvious: yet it had not occurred to surgeons generally, until it was suggested by the late Sir Everard Home; and to him we are indebted for this very great improvement in practical surgery. The immediate effect of drawing off the water is to give the patient the greatest comfort. He loses the irritation which tormented him before; he is free from pain; and is no longer harassed by the incessant desire to make water. But the relief is only temporary. In a few hours the bladder is again loaded, and the symptoms return. The catheter is then to be introduced again; and you must continue to introduce it at regular intervals. These intervals will vary in different cases. One patient is quite comfortable if the urine be drawn off twice in the twenty-four hours, while another requires it to be done every six or eight hours. I never, except under peculiar circumstances, recommend the catheter to be used oftener than this. If employed six or eight times in the day and night, it is likely to irritate the prostate, and to do harm instead of good. This plan is to be pursued, probably, to the end of the patient's life. It may be distressing to him to be thus dependent on the use of the catheter, but it is the least of two evils. The repeated introduction of it is an inconvenience, but it prevents misery and

destruction. Without it, slow inflammation of the mucous membrane of the bladder, extending along the ureters to the kidneys, will supervene; abscess will form in the prostate; and probably stone in the bladder. But where the catheter is used regularly, these evils are at any rate delayed for a considerable time, and in by far the greater number of cases are prevented altogether.

But is the patient to be subject to the daily attendance of a surgeon for the remainder of his life? This cannot be necessary. Let him learn to introduce the catheter for himself. If possible, let him use the gum catheter without the wire or stilet. It is less likely to occasion irritation than a harder instrument, and he can never with this do himself any material injury.

Now, it is this continued use of the catheter, in those cases in which the patient is unable completely to empty the bladder by his own efforts, which constitutes the principal part of the treatment to be employed in ordinary cases of disease of the prostrate gland. In some cases nothing more is required; and the patient who is dexterous in the use of the catheter, and who is careful never to neglect the regular introduction of it, passes through the remainder of his life, an invalid indeed, but with little or no actual suffering; and probably dies at last of some other disease, entirely independent of that which exists at the neck of the bladder.

But there are many cases in which this is not in itself sufficient, and in which other treatment is necessary to remove or palliate the distressing and even dangerous symptoms which arise in the progress of the complaint.

When the mucous membrane of the bladder is affected by slow inflammation, the patient complaining of augmented irritation and pain, and the urine depositing ropy, adhesive, alkaline mucus, you are to employ those remedies which I recommended formerly under these circumstances, when speaking of diseases of the bladder; such as small doses of the cubebs pepper; the decoction of the pareira brava, combined with tincture of hyoscyamus; opiate clysters or suppositories; and rest in the horizontal posture. By proper attention, you may generally relieve the symptoms of

chronic inflammation of the mucous membrane which occur in consequence of a diseased prostate, when they exist in a moderate degree. When, however, the case has been long neglected, and the inflammation has extended from the bladder to the ureters and kidneys, neither these nor any other remedies will be of real service, and the patient will sink, in defiance of all your skill, under his complicated maladies.

If the patient labours under such symptoms as lead you to believe that there is inflammation of the prostate, which, if it proceeds, may terminate in the formation of abscess, take blood from the perineum by leeches or cupping, administer gentle aperient medicines, and advise him to avoid all but the most moderate bodily exertions. By these means you will often succeed in preventing suppuration from taking place. If abscess, however, be already formed, and has burst in the perineum or into the rectum, nothing is required, or at least nothing can be done, beyond maintaining as much as possible the general health, so that the power of the patient's constitution may be under the most favourable circumstances for repairing the mischief which has taken place. If the abscess has burst into the urethra, or at the neck of the bladder, it is very desirable to avoid, for a time, the frequent introduction of the catheter, the point of which is liable to become entangled in the abscess, producing a fresh attack of inflammation, and perhaps sloughing of its inner surface, with a train of dangerous constitutional symptoms. Under these circumstances, I generally allow the gum catheter to be constantly retained in the urethra and bladder, until there is reason to believe that the abscess is healed. The catheter used on these occasions should be rather less than the middle size. A catheter, which completely fills the canal of the urethra, may press on the orifice of the abscess so as to interfere with the free discharge of its contents, and thus may increase the evil which it is intended to remove. In some cases, however, after the formation of abscess, the neck of the bladder becomes so tender, that the constant retention of the catheter cannot be endured. We have then no alternative;

the catheter must be used at stated periods, great care being taken that it should not penetrate into the cavity, nor even into the orifice of the abscess.

An abscess which has an external opening will generally discharge its contents more freely, and therefore will heal more readily, than one which has burst into the bladder, or urethra, or rectum. Whenever, therefore, the symptoms lead us to suspect that suppuration is taking place, we should from time to time examine the perineum and scrotum, and not hesitate, where any tumour can be discovered, to make a puncture with a lancet, without waiting for it to present itself at the surface.

In those cases in which there is reason to believe that the diseased prostate is in a state of ulceration, the distressing symptoms which arise are to be combated chiefly by the free use of opium, administered in the form of clysters or suppositories. In some instances, the patient enjoys on the whole more comfort if the catheter be allowed to remain constantly in the urethra and bladder; in other instances it is the reverse, and the catheter must be introduced occasionally, that is, whenever a moderate quantity of urine is collected in the bladder, being withdrawn immediately on the bladder being emptied.

Hæmorrhage from the prostate gland is to be treated like any other internal hæmorrhage; and it will cease in ordinary cases if you take blood from the loins by cupping, administer a saline purgative, and keep the patient on a low diet, and in the horizontal posture. Where the hæmorrhage is unusually great, blood may be taken from the arm with a view to lessen the force of the heart's action, the loss of blood in this manner being a much less evil than an internal hæmorrhage. Those medicines which operate as styptics when taken internally, and which are useful in cases of hæmorrhage from the lungs, are also useful in cases of hæmorrhage from the prostate. I had a patient with very diseased prostate. A frightful hæmorrhage took place. The usual methods of treatment were adopted, but were of no avail. The skin became pale; the pulse became weak; and the patient was

exhausted; yet the bleeding continued. Large quantities of blood were drawn off with the catheter; nevertheless, the bladder continued to become more and more distended with blood, and was felt prominent in the belly as high as the navel. All other remedies having failed, I gave the patient a dose of the nostrum known by the name of Ruspini's styptic, and repeated the dose two or three times in the course of the next twelve hours. In about half an hour after the first dose was taken, the hæmorrhage ceased, and it never recurred.

In this instance the bladder had become distended with blood, forming a tumour in the abdomen as high as the navel; and this great evil remained, although the hæmorrhage had ceased, giving the patient all the torment of a severe attack of retention of urine. In order to relieve him I left a gum catheter in the urethra and bladder, and at intervals injected some tepid water into the bladder with a syringe. Every portion of water dissolved a portion of the blood; and by means of the same syringe I was enabled to draw the blood, which was thus dissolved, out of the bladder. By performing this operation in so careful a manner as not to produce any fresh hæmorrhage, and repeating it over and over again, in the course of forty-eight hours I succeeded in emptying the bladder completely of the blood which had been accumulated in it. The patient lived for a year and a half afterwards, and there was no reason to believe that any ultimate harm arose from the bleeding. This case occurred in the early part of my professional practice. Since then many cases have fallen under my observation, in which the bladder had become distended with blood, and I have found it convenient to have a simple apparatus made for the special purpose of giving the patient relief under these circumstances. The apparatus consists of a silver catheter of as large a size as the urethra will admit, having a large aperture on its concave side, near the extremity which enters the bladder; and an elastic gum-bottle capable of containing half a pint of fluid, with a stopcock fitted to it, adapted to the other extremity of the catheter. The catheter having been introduced, as much of the bloody contents

of the bladder are drawn off as the accumulation of coagulum will allow to flow. Then by means of the gum-bottle some tepid water is injected into the bladder, which by dissolving a part of the coagulum, and breaking down another part into smaller portions, enables another quantity of blood to be discharged. By repeating this process the bladder may be completely emptied in the course of a short time, without pain or other inconvenience to the patient.

So far the treatment of the chronic enlargement of the prostate gland is sufficiently simple. It becomes more difficult, and a greater degree of circumspection is necessary in forming a prognosis, in those cases in which the original disease is complicated with a secondary disease of the kidneys.

Here the first thing to be done is to remove the exciting cause of the secondary disease, by having recourse to that treatment which will relieve the primary; and if the disease in the kidneys has made but little progress, you will find that it subsides spontaneously, as soon as the accumulation of urine in the bladder is prevented by the regular introduction of the catheter. If, on the other hand, it be far advanced, it is but too probable that it will proceed to an unfavourable termination, notwithstanding all your efforts to prevent it. Still art may do much in certain cases. If there be a quantity of adhesive mucus in the urine, indicating the existence of chronic inflammation of the mucous membrane, you may, as I have already mentioned, administer the decoction of the pareira brava with tincture of henbane, or small doses of the cubebs pepper. If the urine be free from this kind of mucus, but opaque, turbid, albuminous, or depositing pus, you may give the patient the infusion of diosma in the manner which I recommended formerly. At the same time, the powers of the patient should be maintained by means of a nutritious diet, with a limited quantity of ale or wine. If there be much pain in the loins, stimulating liniments or mustard poultices may be applied twice daily, or a blister occasionally. Still the use of the catheter is indispensable, as it would be unreasonable to expect that any

remedies should act on the disease in the kidneys, while the cause that has produced it continues to operate.

Yet, however necessary it may be in all cases, there are some in which much discretion is required in resorting to the use of the catheter. What I am about to state is not an opinion formed hastily, but a deliberate conclusion, to which I have been led, after having had, for many years, no small share of experience in the treatment of these disorders, as well as considerable opportunities of investigating the morbid appearances which they leave behind them in the dead body. If, in a case of chronic enlargement of the prostate, the patient has been allowed to go on for two or three years, or longer, without the use of the catheter, and, in consequence of this neglect, the quantity of residuary urine in the bladder has gradually increased, so that at last one or two, or more pints are accumulated in it, the kidneys having at the same time become diseased, the introduction of the catheter, according to the rules formerly laid down, so as to empty the bladder two or three times daily, is likely to be injurious rather than beneficial. The patient is, it is true, relieved of many of his distressing symptoms. He is no longer tormented by a frequent desire to void a small quantity of urine, nor by an involuntary dribbling of urine during the night; nor does he suffer the uneasy sensations which, in a greater or less degree, always attend an over-distended bladder; but, in the course of a few days, it is observed that he avoids his usual exertion, that he seems languid, and loses his disposition to take food. Then the other symptoms of diseases in the kidney, which were but imperfectly developed before, become distinctly marked, and he gradually sinks, and dies at the end of a month or six weeks from the time of the catheter being first employed.

I shall describe to you more at length, in a future lecture, what are the consequences of the operation of lithotomy performed on a person who labours under any considerable disease of the kidneys. At first he is greatly relieved, and often seems to recover rapidly from the effects of the operation; but, in the

course of a few days, his bodily powers begin to fail, and death ensues at no distant period, and this happens even where the stone has been of a small size, extracted in the shortest possible space of time, and with the least possible injury to the parts concerned. The resemblance between the effects produced by the use of the catheter, in the way and under the circumstances which I have just endeavoured to describe, and those which follow the operation of lithotomy in a patient similarly circumstanced, is too obvious to be overlooked; and I conclude that they are to be referred to a common principle. The system suffers from the shock of the operation, in one case; and in the other case it suffers in the same manner from the impression made on it by the sudden emptying of the over-distended bladder, and consequent removal of the pressure which is made, through the medium of the dilated ureters, on the glandular structure of the kidneys.

Here, then, arises an important practical question. The patient has no chance of recovery without the use of the catheter. Are we to leave him to his fate? or are we to empty his bladder at certain intervals, at the risk of hastening the period of his dissolution? I have no doubt that we may, in many instances at least, obtain the good and avoid the evil, by a slight modification of the treatment. Let the catheter be introduced at first so as to draw off only a portion of the contents of the bladder, and let several days be permitted to elapse before it is completely emptied; care being taken, at the same time, to uphold the general health by the exhibition of ammonia, quinine, and other tonics, exhibited according to circumstances, and combined with the prudent use of wine or brandy and a plain but nutritious diet.

SCIRRHUS OF THE PROSTATE GLAND.

I have observed that malignant diseases of the prostate are of rare occurrence. I have, however, seen cases in which I could not well doubt that the prostate was affected by scirrhus, although I had no opportunity of positively ascertaining the fact by dissection.

In February, 1831, a gentleman from Maidstone, 50 years of age, consulted me under the following circumstances:—

He complained of a too frequent inclination to void his urine; so that he was disturbed not less than ten or twelve times in the course of the night. The act of voiding it was attended with some degree of difficulty; and occasionally he observed that it could not be accomplished in the position in which he then was, and he was under the necessity of altering it. A small quantity of urine sometimes flowed involuntarily after he thought that his bladder was emptied. He suffered a severe and constant pain, extending from the left groin across the lower part of the abdomen above the pubes, and also down the thigh and leg. The pain above the pubes was aggravated during the effort to make water. He compared the pain in the thigh and leg to that which he suffered on a former occasion when he had sprained his thumb, and said that it prevented his throwing the weight of his body on that limb when he stood erect. There was an enlarged and indurated gland in the groin on the side to which the pain was referred. The urine was high coloured, but otherwise in a healthy state, free from mucus and albumen. A catheter having been introduced after he made water, it was ascertained that there was no obstruction in the urethra, and no residuary urine was found in the bladder. He had lost flesh, and had the aspect of a person labouring under a malignant disease. He was hot and feverish at night, and the pulse was never less than 100 in a minute. The prostate gland being examined from the rectum, was found not very much enlarged, but of a stony hardness.

The symptoms which I have described first showed themselves in the preceding August, and had gradually increased up to the time of my being consulted.

It appeared to me that the circumstances of this case could not well be explained, except on the supposition of the prostate gland being affected with the true scirrhous disease; and Mr. Travers, who was consulted, also came to the same conclusion.

The patient returned to Maidstone, and died shortly afterwards. There was no opportunity of examining the body after death.

Another case fell under my observation, in which, also, I was led to believe that the patient laboured under scirrhus of the prostate. I preserved no notes at the time, but I know the following history to be accurate as far as it goes:—

A gentleman, about 60 years of age, who had been long in India, consulted me a few years ago, respecting what appeared to be a chronic enlargement of the prostate gland. There was nothing unusual in its symptoms, and I merely recommended to him the regular use of the catheter. From this treatment he derived much benefit, and he persevered in it ever afterwards.

It was not less than five or six years after this period that I was requested to see him again, in consultation with Dr. Latham and Mr. Mawdslay. He now could void no urine without the assistance of the catheter. There was a constant and most severe pain, referred to the neck of the bladder, which was not relieved on the urine being drawn off. The urine deposited a considerable quantity of adhesive mucus, and was of an ammoniacal odour. The prostate gland, examined by the rectum, was found to be much enlarged, and of a stony hardness. From these circumstances we were led to suspect that the prostate had become affected with a true scirrhous disease; and, in confirmation of this opinion, we found the patient complaining of excruciating pains in various parts of the body, sometimes in one part, sometimes in another, which could be compared to nothing except the pains under which persons afflicted with carcinoma occasionally labour. Altogether, I may say, that I have never seen a human being whose sufferings were more intense; and they were scarcely mitigated by the exhibition of very large doses of opium. I continued to visit him occasionally, in consultation, for nearly a year, at the end of which time he suddenly lost the use of the muscles of his lower limbs, and died in a fortnight afterwards. Permission was not obtained to examine the body; but it is worthy of notice, that a lady whose

case is related in the eighth chapter of the last edition of my work on 'Diseases of the Joints,' and who had long laboured under carcinoma of the breasts, died after a similar attack of paralysis of the lower limbs, and that in her it was ascertained by dissection, that the cause of the paralysis was a conversion of the bones of the spine into the scirrhous structure.

LECTURE IX.

ON URINARY CALCULI.

The urine in its natural state is composed of various ingredients, which are maintained in solution as long as they preserve the temperature of the body. Sometimes, however, it happens that one or more of these ingredients is deposited in a solid form, although the urine has undergone no alteration in its temperature, and even while it remains in the bladder, or in some other of the urinary passages. These deposits may be in the form of small particles, or sand; or in larger masses. We call these latter calculi. Whether there be merely sand, or whether there be actual calculi, the nature of the disease is essentially the same; and it is to these calculous disorders that I call your attention in this and the following lectures. The subject is one of the highest interest, on account of the number and variety of the phenomena which it embraces; on account of the pain, distress, and deep anxiety which the patient suffers; and on account of the great relief which the art of surgery is capable of affording in the majority of these cases.

OF SAND IN THE URINE.

The urine contains a large quantity of a peculiar acid, first accurately described by Schele, who gave it the name of uric acid, but to which the name of lithic acid is more commonly applied by the chemists of this country. It was formerly supposed that the pure acid was held in solution by the urine. Dr. Prout, however, has shown that the pure acid is almost insoluble, and that, under ordinary circumstances, it exists only in the form of lithate of ammonia, which is a very soluble salt. It is this, and not the

uncombined acid, which causes healthy urine to redden litmus paper. In very cold weather the urine, as it cools, deposits the lithate of ammonia, blended with some other animal matter. It is the lithate of ammonia, also, which forms the principal part of the soft or uncrystallised sediment deposited in the vessel by the urine of persons who labour under dyspepsia and some other bodily ailments.

Now, if you add to healthy urine some kind of acid, for which ammonia has a stronger affinity than it has for the lithic acid, the juice of a lemon, for instance, the lithate of ammonia is no longer precipitated; but in its place you find a number of small crystals, resembling particles of Cayenne pepper, sometimes of a light brown, but more frequently of a dark-red colour, at the bottom of the vessel. These are composed of the pure lithic acid. The lemon juice unites with the ammonia, and the lithic acid, being nearly insoluble, is precipitated. This, which happens out of the body, may happen in the body also. The presence of another acid in the urine causes the lithic acid, even in the bladder, to be precipitated in the form of a red sand. Dr. Prout says that it is usually the lactic acid which produces this effect. However that may be, we find that those who are liable to the formation of acid in the stomach are especially liable to the deposition of the red sand. If the digestion be weak, whether it be that the food itself becomes acescent, or that acid is secreted in too large quantity by the stomach, the red sand shows itself. If the food be indigestible, or if it be taken in too large quantity, the same effect may be produced even in the most healthy person. The free use of fermented liquors, and especially of those which contain acid already, or sugar, which may become acid in the stomach, such as punch and champagne, leads to the same result. Persons who lead a sedentary life, and who never take exercise so as to produce perspiration, are also especially liable to the formation of red sand. Dr. Philip has made some interesting observations relating to this last point, which are of much practical importance You will find them recorded in a paper published by Dr. Philip, in one of the

volumes of the 'Medical Transactions of the College of Physicians.' It seems as if, during perspiration, something was caried off from the blood in the cutaneous vessels, which would otherwise cause the urine to be loaded with acid. Sir Gilbert Blane long ago observed that a disposition to calculous disorders is frequently combined with eruptions on the skin (psoriasis), and Dr. Philip's observations will explain the reason of this association.

When the urine contains a superabundant acid, which precipitates the lithic-acid sand, it usually is bright and transparent to the eye, and of a copper colour, resembling in appearance Madeira wine. In general the patient is troubled more or less with dyspeptic symptoms, and frequently he is liable to gout. Many circumstances demonstrate a close connection between this last disease and the formation of the brown or red sand in the urine. The same peculiar constitution, the same luxurious diet, the same inactive life, which makes the patient subject to the one, makes him also subject to the other. The red sand is composed of crystals of lithic acid in its pure state; while the chalk-stones, which are formed in the bursæ and cellular membrane of gouty patients, are composed of the same acid, in combination with soda; and the red or yellow deposit from the urine of gouty persons consists of the lithate of ammonia coloured by other matters.

In the (so-called) better classes of society, you will find the deposition of red sand to exist chiefly in adult persons, but in the lower classes you find it chiefly among children. These circumstances are easily explained. Adult persons in affluent circumstances, for the most part, lead a more luxurious and indolent life than their children; while among those of lower condition the diet of the children is frequently unwholesome, and comparatively little attention is paid to the various derangements of the digestive organs to which they are liable.

In many instances, the red sand is voided without any particular symptoms to indicate its formation, and the patient discovers the disease only by seeing it in the urine; but at other times he complains of uneasy sensations in the loins, of pain in the groins,

and in the course of the urethra; and sometimes a small quantity of blood is discharged from the urethra, in consequence of its being abraded in some one part by the sharp hard angles of the crystals. Where the urethra is irritable and liable to spasmodic affections, the contact of the red sand induces spasm in it, occasioning a diminution of the stream, and even difficulty of voiding the urine. In such cases you in vain endeavour to cure the stricture merely by the use of bougies; but if you employ at the same time such remedies as tend to prevent the formation of the red sand, you cure the stricture easily.

It is of great consequence that you should prevent the formation of red sand, both because it is in itself a considerable evil, and because, if neglected, it may lead to the formation of a larger concretion in the bladder. You may generally accomplish this object by conveying alkaline remedies into the stomach, such as potash, soda, limewater, ammonia, magnesia. Sometimes one, sometimes another, may be preferable, according to circumstances; and sometimes it may be advisable to give them in combination with each other. If the lithic acid be deposited in small quantity, and the bowels be too much relaxed (which, however, rarely happens in these cases), limewater may be useful. In persons of weak bodily powers, who may be supposed to require cordial and stimulating remedies, you may exhibit ammonia. Dr. Prout recommends the carbonate of potash in preference to the carbonate of soda, for the following reason:—that the soda, under certain circumstances, will enter into combination with the lithic acid, forming an insoluble salt, as bad as the lithic acid itself; whereas the lithate of potash is perfectly soluble; and if this combination takes place, it will pass off dissolved in the urine. Magnesia, as recommended by Professor Brande, has much to recommend it. Being in itself insoluble, it cannot enter the circulation except it has first become combined with acid in the stomach or intestines; and hence it does not pass out of the system so soon as the alkalies.

I have mentioned the *carbonates* of potash, soda, and ammonia, as these agree better with the stomach, and therefore are more

proper to be employed than the pure alkalies. The carbonic acid does not interfere with their medicinal effects. There is a remarkable difference in the effects produced on these disorders by the salts, which contain a mineral, and those which contain a vegetable acid. The sulphates, muriates, nitrates, are of no avail; but the tartrate of potash, the tartarised soda, the common saline draught, composed of citric acid and potash, all produce the same effect as the pure alkalies, or as the alkalies combined with carbonic acid. This remarkable circumstance was first noticed by Sir Gilbert Blane. Sir Gilbert has also recommended a very efficient method of exhibiting the carbonate of potash in these cases, by giving it in a saline draught with an excess of alkali.

I have said that different doses of the alkaline remedies will be required in different instances. Indeed a good deal of care is generally necessary to adjust the dose to the peculiar circumstances of the individual case. If you give too little of the alkali, the result is not obtained, and the lithic acid is still deposited, although in smaller quantity. If you give too much, you not only prevent the formation of the red sand, but you render the urine alkaline, and a white sand (the triple phosphate of ammonia and magnesia) is deposited in its place. Other ill consequences follow the too liberal exhibition of alkalies. I conclude that they produce some kind of alteration in the quality of the blood. After some time the patient is liable to petechiæ; he perspires too easily, becomes low-spirited, and less capable than when in health of physical exertion. Magnesia does not produce these affections, at any rate not to the same extent, as no more of it can enter the circulation than what is rendered soluble by its combination with acid in the stomach. Too large doses of magnesia, however, are mischievous in another way, by causing the formation of magnesian calculi in the intestines. These are composed of magnesia mechanically blended with the fæces and intestinal mucus. They were not of uncommon occurrence a few years since, when many individuals were in the habit of taking magnesia in a careless and profuse manner. I have in several instances known a person to

suffer a good deal of distress from such a calculus being lodged in the rectum. But cases have occurred, in which the accumulation of magnesia in the intestine has taken place to a very great extent. The late Mr. Wilson examined the body of a patient in whom, if I recollect rightly, some pounds of magnesia were found collected in the colon above a contracted part of the rectum.

In the exhibition of alkaline remedies, then, you must make each case the subject of a distinct experiment; and that the experiment may be more properly conducted, you must, if possible, make the patient enter into your views, that he may assist your practice by his own observations. He should be provided with paper, coloured blue by an infusion of litmus; and also with the same paper, slightly reddened by an immersion in a very weak acid. Healthy urine ought to turn the blue litmus paper a little red; and you should avoid giving alkaline remedies in such a dose as to destroy this property altogether; still less ought they to render the urine alkaline. If the urine turns the red paper blue, the patient is in danger of suffering from a deposition of the phosphates, and the alkalies must be given in smaller quantity.

It is to be further observed, that the time when the urine is most acid, and when the alkalies are most required, is after the principal meal, that is, after dinner. The alkalies are not indeed to be given immediately after dinner, for then they are likely to interfere with digestion; but four or five hours afterwards. In some cases it is better for the patient to defer taking his medicine until he wakes accidentally in the middle of the night. In many instances, a single dose daily, and that at bedtime, is all that is required; while in others the magnesia or alkali should be exhibited in the middle of the day also.

It appears to me that it has been the custom of late years to give these remedies in larger quantities than is really necessary. It rarely happens that half a scruple of magnesia, or a scruple of the bicarbonate of potash, is not sufficient to neutralise the superabundant acid in the stomach after dinner; and, where a second dose is wanted, half this quantity may be given in the middle of

the day. The following combination agrees very well with the stomach, and produces a very immediate effect on the urine:—

℞ Magnesiæ, gr. vj.
Potassæ bicarbonatis, ℈ss.
Potassæ tartratis, gr. xv.—Misce. Fiat pulvis quoque vespere sumendus e cyatho parvo aquæ.

But it may truly be observed that this is not striking at the root of the disorder. Alkalies prevent the formation of red sand while they are being taken, but they do not prevent it being formed again as soon as they are left off. There is even reason to believe that the habitual use of alkalies increases the disposition of the stomach to generate acid: at all events the patient cannot well take them for ever; and something further, therefore, is required. When he suffers from costiveness, purgatives must be exhibited; and even in those cases in which the bowels are not particularly torpid, purgatives are required. The mercurial purgatives are very useful in these cases. A blue pill may for a short time be administered every night, with a draught of infusion of senna and tartrate of potass every third or fourth morning; or a calomel pill may be given once in a week or fortnight, at bed-time, and the senna draught on the following morning. When the disease is connected with gout, the patient may take the colchicum with great advantage. In the first instance fifteen drops of the vinum colchici may be administered twice daily; afterwards, a draught of infusion of senna, with a saline purgative, and half a drachm of the vinum colchici, may be given occasionally in the morning, or from one to two grains of the acetous extract of colchicum combined with the same quantity of the blue pill (pilula hydrargyri) may be given as a pill for eight or ten successive nights.

But more, after all, is to be effected by attention to diet and mode of living than by medicine. Is the patient a great eater, pampering his appetite by a variety of dishes, and thus exciting himself to swallow more food than his stomach can readily digest? —let him make his dinner on a single dish, and eat of that in

moderate quantity. Let him also incline to a diet of vegetable rather than one of animal food, avoiding, however, undressed vegetables, and especially those which are acid or acescent; as salad, oranges and apples. Does he commit excesses in drinking? —let him leave off fermented liquors altogether, or take them only in small quantity; and in particular let him avoid such fermented liquors as, from the sugar which remains unfermented in them, are liable to become acid in the stomach, or which are acid already. The French white wines are injurious in these cases, especially champagne; so are all the varieties of malt liquor, from Burton ale down to home-brewed beer; but none of these liquors are worse than our old-fashioned English liquor called punch.

If your patient has been in the habit of dining late in the evening, going to bed soon after a hearty meal, he should alter his habits in this respect; dining sufficiently early to allow of his food being digested before he retires to rest. If he has led a sedentary life, he should cease to do so; walking or riding daily, so as to induce perspiration. A person who takes a good deal of exercise may take liberties as to diet, which he could not otherwise take with impunity. For example—a gentleman of my acquaintance was accustomed to dine daily in convivial society, eating and drinking heartily, and not stinting himself in the use of hock and champagne. But he was of active habits. He rose early in the morning, walked for an hour or two before breakfast, and came home to breakfast perspiring profusely. If by chance, in his morning's walk, he met any one of his friends, his remark was, that he was walking to distil off the champagne which he had drunk yesterday. By and by some circumstances occurred which altered his mode of life in this respect; and not long afterwards he consulted me concerning two symptoms which gave him some trouble and anxiety; the one, a quantity of red sand in the urine, and the other, a scaly eruption (psoriasis) of the skin. He had continued to eat and drink as usual, but he had ceased to rise early, and to take his long walk, which brought him home per-

spiring to breakfast; and this alteration in his habits was soon followed by the appearances of the red sand and the eruption. A gentleman of my acquaintance, who has for many years indulged himself not only in eating but also in very liberal potations of wine daily, and who has lived luxuriously otherwise, nevertheless retaining the most perfect health and cheerfulness, attributes his exemption from the usual ill consequences of such a mode of life to the circumstance of his being accustomed to perspire profusely during the night.

A copious perspiration may be produced in other ways, as well as by means of exercise. The most certain and effectual method is the use of the sulphur-fumigating, or hot-air bath. The hot-air bath is certainly of great advantage to those persons who, having led an inactive life, are subject to dyspepsia, and those twinges in the limbs, especially in the feet, which sooner or later are followed by a regular attack of gout; and I believe that it may also be employed beneficially in cases in which the patient suffers from a too large proportion of lithic acid in the urine. It is worthy of observation, that the perspiration produced by the hot-air bath is highly acid, reddening the blue litmus paper nearly as much as it is reddened by acid urine. Such, indeed, is the character of this secretion generally, and thus the beneficial effects of a free perspiration are easily explained. As the introduction of any acid into the stomach may promote the development of the lithic acid in the system, so it may be supposed that the abstraction of any acid from the skin may produce the same result. The fact, however, may be explained in another manner. Dr. Prout says that, for the most part, the precipitation of the lithic-acid sand is caused by a superabundance of the lactic acid in the urine. But the lactic is supposed to be the predominant acid in the perspiration. Probably each of these explanations is correct as applied to different orders of cases.

The red or lithic-acid sand is not the only sand deposited by the urine. In some instances there is a deposit of the lithate of soda in the form of a white sand. This, however, is of comparatively

rare occurrence. The more common form of white sand consists of minute crystals of the triple phosphate of ammonia and magnesia. Here the urine is not acid, but of an alkaline quality: it turns the reddened litmus paper blue, and, if very alkaline, it turns the yellow turmeric paper brown; or it may be slightly acid when first voided, becoming alkaline afterwards, and having a pellicle on its surface, which shows the prismatic colours, and is composed of the salt just mentioned. According to Dr. Prout, the formation of the white sand takes place in the following manner:—The urine, under ordinary circumstances, contains the phosphate of magnesia, which is held in solution, being a highly soluble salt. But in some cases of disease, the urea of the urine becomes decomposed in the kidneys, and ammonia is evolved, which combines with the phosphate of magnesia, so as to make a triple salt. But the triple salt is insoluble, and, therefore, it is precipitated in the form of a white sand. Dr. Prout observes also, that the same state of system which leads to the decomposition of urea and the evolution of ammonia leads also to a more abundant formation of the phosphate of magnesia; and hence arises the immense deposition of white sand, which occurs in some cases. Indeed, this is sometimes so great, that the quantity of phosphate of magnesia, which healthy urine contains, will by no means account for it. I performed the operation of lithotomy on a boy, whose urine, after the operation, deposited such a quantity of the triple phosphate, that his perineum, the inside of his thighs, and the bed-clothes, had the appearance of being dusted over with a white powder! and if this was wiped off, the appearance was renewed in the course of a few hours.

The existence of the white sand in the urine is no new discovery: it having been described by writers, under various appellations, even before Dr. Wollaston ascertained its chemical composition. It was not, however, until the investigation was taken up by Dr. Prout, that any just notions were formed as to the peculiar circumstances under which this salt is generated.

The state of the system which leads to the production of

alkaline urine, and of white sand, is very different from that which is attended with a too acid condition of the urine, and the formation of red sand. The latter, as I have already stated, occurs in individuals who are over-fed, or over-stimulated, and whose vital powers are not exhausted by exercise; where there is what Dr. Cullen would have called a sthenic diathesis. But the alkaline urine indicates an asthenic state of the system; it is the result of debility. In a person who is exhausted by too severe mental or bodily exertions, or who has long been worn by mental anxiety, the urine becomes alkaline. A gentleman, who was at that time attending these lectures, called on me to consult me concerning his general health. After a careful inquiry into the circumstances of his case, I was unable to discover any marks of local disease. It was not one function in particular, but all his functions were deranged. He had been in the habit of sitting up to write out his notes until two in the morning; he had risen from his bed at six; he had worked all day, both with his hands and with his head; in short, he was suffering from excessive labour of both body and mind. I said to him, 'Your case is not one which medicine alone will cure; you must study less, and sleep more. Your system is in that state which will lead to your having alkaline urine, if you have it not already.' He went into the adjoining room to make water, and immediately on its being voided I tested the urine, and found it to be alkaline, as I had anticipated. I mention this case, that the important fact which it illustrates may be well impressed on your minds; but cases corresponding to it are not uncommon.

In many instances, a course of mercury renders the urine alkaline. In some individuals, even a single dose of calomel will produce the same effect. Mercury is what is commonly called a lowering medicine, and this seems to explain the principle on which it operates. In a person who is already weak, the further degree of exhaustion, which is the consequence of the exhibition of an active purgative, will be sufficient to make the urine alkaline. The too abundant exhibition of alkaline remedies will. as indeed might be expected, lead to the same result. Injuries of the

spine, affecting the spinal chord, are often followed by the secretion of alkaline urine. I first observed this fact as long ago as the year 1807, and have taught it in my surgical lectures from the time that I began to deliver them in the year 1808. Since then the observation has been confirmed, not only by my own experience, but by that of many other individuals. It is remarkable that this effect is equally produced whatever is the part of the spine that is injured; whether it be the loins, or the back, or the neck; whether the bladder be, or be not, paralytic. It continues even after the patient has recovered of all his other urgent symptoms. I was consulted by a gentleman who had met with a severe injury of the spine more than a year before. Immediately after the accident had occurred, his limbs had become paralytic, but he began to regain the use of them in the course of a few weeks; and when he applied to me he could walk and ride like other persons, but his urine was still alkaline. The same thing occurs where there is disease of the spinal chord independent of mechanical injury. I have lately attended a gentleman who laboured (as the post-mortem examination proved) under a disease affecting the lower half of the chord. It had lost its natural structure, and was in that state to which Rostan has applied the name of ramollissement. There was some reason to believe that in this case the disease had been induced by excessive venery—that it was a true tabes dorsalis. One symptom was a half-paralytic state of the muscles of the lower limbs, so that the patient could scarcely walk even with the assistance of crutches;* another was a highly alkaline condition of the urine with a deposition of ropy adhesive mucus. In this case, in the commencement of the paraplegia, the urine was unusually acid, and it was only as the paraplegic symptoms advanced that it be-

* For some further observations on the influence of injuries of the spinal chord on the secretion of urine, and the effects which these injuries produce on the kidneys and bladder, I may refer to my memoir on injuries of this part of the nervous system, published in the 20th volume of the 'Medico-Chirurgical Transactions.' This paper will be found in Volume III.—C. H.

came alkaline. This confirms a remark which Dr. Prout has made, that alkaline urine is frequently preceded by a too abundant formation of lithic acid. In females who labour under what may be regarded as aggravated hysterical affections, the urine is frequently alkaline, and deposits the triple phosphate in abundance. The same persons are also liable to have the red or lithic-acid sand in the urine; and not unfrequently the two kinds of sand alternate with each other. It is astonishing what a quantity, sometimes of lithic acid, and sometimes of the triple phosphate, passes off with the urine in some of these cases.

Those persons who habitually secrete alkaline urine are generally pale and sallow; incapable of much bodily and mental exertion; complaining of lassitude and weariness, and when this state of things has existed for some time, their bowels become irregular, being sometimes too much confined, at other times too much relaxed; and they exhibit other marks of debility. Such is the description of the symptoms connected with the secretion of alkaline urine given by Dr. Prout; and your future experience will enable you to bear testimony as to the general correctness of this statement. There are, however, cases to which it does not apply; and I have at this time under my care a gentleman whose urine is alkaline, and has been so for a considerable time, although his general health is good, and he has no other ailment, with the exception of a costive state of the bowels. The urine in its alkaline state, instead of the transparent coppery appearance which it possesses, when it is too acid, is voided slightly opaque; of a pale colour, like whey; and being secreted in too large quantity and much diluted, it is of a low specific gravity. The odour is unnatural and disagreeable: sometimes ammoniacal. The addition of a mineral acid renders it transparent. When allowed to stand, even for a short time, the triple phosphate is deposited in the form of a white sand, which often to the naked eye assumes an appearance like that of pus; at the same time that a pellicle is formed on its surface, which shows the prismatic colours, and which Mr. Brande has ascertained to be composed of

the triple phosphate also. If allowed to stand for a longer time, the urine becomes putrid, and has the odour of ammonia.

Besides the triple phosphate of ammonia and magnesia, another salt, into the composition of which the phosphoric acid enters, is frequently to be detected in the urine; namely, the phosphate of lime. A small quantity of this salt seems to be occasionally generated by a diseased kidney; but by far the greater proportion of it is derived from another source.

Dr. Austin, physician to St. Bartholomew's Hospital, in the year 1791, published a 'Treatise on Stone in the Urinary Bladder,' in which he states that 'the main result of his inquiries has been, that the stone is formed generally in very small part, and often in no degree whatever, from the urine as secreted in the kidneys, but chiefly from mucous produced from the sides of the different cavities through which the urine passes.' The late Mr. Chevalier, in the second volume of the 'Medico-Chirurgical Transactions,' published some observations which were intended to confirm Dr. Austin's hypothesis. These notions, however, attracted but little attention, even when first promulgated; nor is this to be at all wondered at, when we consider how much they are at variance with a multitude of well-known facts. Nevertheless, they are not absolutely without foundation. Dr. Austin was in an error, inasmuch as he mistook the exception to the general rule for the rule itself; but no further. It is true that calculous matter in by far the greatest number of instances, is a deposit from the urine, but under certain circumstances it is generated by the mucous membrane which lines the bladder, and extends from thence along the ureters to the pelves and infundibula of the kidneys.

I have described in a former lecture the phenomena which belong to chronic inflammation of these mucous membranes. One of its effects is the secretion of a tenacious ropy mucus in a most abundant quantity. This mucus is highly alkaline, containing the carbonate of soda, which is a soluble salt; containing also the phosphate of lime, which is insoluble. The latter is frequently seen presenting the appearance of white streaks in the mucus.

In some cases it is produced in still larger quantity, and it comes away in irregularly formed masses resembling mortar.

I shall explain hereafter that phosphate of lime is sometimes deposited in a diseased kidney. A case came under my observation in which it descended from thence into the bladder, in the form of a thick white paste, the ureter on the side of the disease being found, after death, distended with the same substance.

There can be no doubt that the formation of phosphate of lime in the urinary organs generally takes place in the way which I have now described. But we sometimes find the urine to contain phosphate of lime in the form of a whitish impalpable powder, which falls like powdered starch in the bottom of the vessel in which the urine is received. Dr. Prout describes the urine in the majority of these cases as being of a pale colour, of a low specific gravity, though it is sometimes quite otherwise. In such cases, there being no sign of chronic inflammation, and little or no mucus in the urine, it seems probable that the phosphate of lime is secreted not by the mucous membrane, but by the structures which secrete the urine.

The urine which deposits the triple phosphate of ammonia and magnesia is not always alkaline in the first instance, but in such cases it becomes alkaline very soon after its expulsion from the bladder. The same observation applies to the urine, which deposits the phosphate of lime. The urine itself may be acid, but it deposits an alkaline mucus in which the phosphate of lime is contained, and this mucus very soon imparts its alkaline quality to the urine.

The triple phosphate of ammonia and magnesia and the phosphate of lime, having in the great majority of instances different origins, either of them may exist in the urine independent of each other. But it continually happens that you find these two varieties of the phosphates coexistent in the urine; and this combination is probably produced in one of the following ways:—

1. The primary disease may be a secretion of alkaline urine in

the kidneys, and consequent production of the triple phosphate. The alkaline urine is an irritating application to the membranous surfaces with which it comes in contact. If it continues for a certain time, it induces a chronic inflammation of the mucous membrane of the kidneys and ureters, extending to that of the bladder, and the formation of adhesive mucus, containing the phosphate of lime:

2. In other cases, a chronic inflammation of the mucous membrane of the bladder is the primary disease. This cannot exist long without affecting the constitution. It excites, not inflammatory fever, but a low febrile disturbance of the system, attended with much general debility. Such a state of system is very liable to occasion a secretion of alkaline urine in the kidneys:

3. In other cases, the secretion of phosphate of lime by the mucous membranes may be a simultaneous effect of the same unhealthy condition of the constitution, which causes the formation of the triple phosphate of ammonia and magnesia in the urine:

And, in one or other of these ways, it happens that the formation of the triple phosphate, and that of the phosphate of lime, are very frequently associated with each other; sometimes one, and sometimes the other, being the original malady.

The treatment of patients in whom the urine deposits the triple phosphate, or white sand, is to be conducted on principles very different from those by which you are regulated where you are required to prevent the deposition of the lithic acid.

The formation of the triple phosphate indicates general debility. Whatever tends to lower the patient aggravates the malady. To this category belong purgatives which produce watery evacuations, and especially mercurial purgatives. All alkaline remedies, such as soda, potash, magnesia, limewater, are (as a general rule) to be avoided also. I have frequently known them to be exhibited by those who have not distinguished the different varieties of calculous disorders from each other, and who had a vague notion of alkalies being good for the gravel, and I have seen them productive of the very worst effects in many instances. I know indeed

that these remedies may be useful where the digestion is bad, even though the urine is alkaline; and I have every now and then met with cases of this description, in which *small* doses of soda were exhibited with advantage; but I am sure that such cases are, as I have already observed, to be regarded, not as constituting the foundation of a general rule, but as exceptions to it. Be assured that the rule is, that alkalies are to be avoided. On the same principle on which you avoid alkalies, you are to exhibit acids. This mode of treatment was first suggested by Dr. Wollaston. Mr. Brande recommended the use of vegetable acids in preference to the mineral. At any rate, these are very fit to be employed where they do not disagree with the stomach so as to interfere with digestion. The patient may drink lemonade, or eat oranges or lemons, in such quantity as he finds necessary. If the vegetable acids, however, as frequently happens, do not agree with the stomach, the mineral acids may be given instead. The dose of the acid must depend on circumstances, and you must regulate it by making frequent examinations of the urine with the reddened litmus and yellow turmeric paper. From five to ten minims of muriatic acid, given three times daily, will generally be sufficient; but in extreme cases you may give as much as thirty or forty minims, or even more, of the strong nitric acid, in the course of the day, sufficiently diluted with syrup and water. The effect of these large doses of nitric acid in correcting the alkaline quality of the urine is most remarkable. I shall mention to you what happened in the first case in which I prescribed them as an experiment. A young man consulted me, labouring under great irritability of the bladder, the consequence of a highly alkaline state of his urine. The urine was voided turbid, of an offensive ammoniacal odour, depositing a large quantity of the phosphates so as to encrust the chamber-pot and turning the turmeric paper of a brown colour. He was at the same time looking ill, languid, and debilitated. These symptoms were the manifest consequence of over-exertion of body and mind. I prescribed forty-five minims of the strong nitric acid, with an ounce of syrup of orange peel

and some tincture of henbane, to be taken daily in a pint of water. The change produced in the urine was immediate. It assumed a better appearance in the course of a few hours; and when I saw the patient again at the end of four days, it had become actually acid, the general health being at the same time manifestly improved.

In these cases all kinds of tonic medicine are likely to be useful, such as bark, sulphate of quinine, bitter infusion, sulphate of iron, the tincture of the muriate of iron, &c. The diet should be plain, but rather generous, and at the same time, such as is easy of digestion; consisting of a due mixture of animal and vegetable food. Fermented liquors may be taken in moderate quantity; and for the most part, the acid wines, as Hock, Moselle, or Chablis, will be preferable to others. Dr. Prout has pointed out the good effects of opium, henbane, and other narcotics. If opium should not interfere with the digestive functions, you may give it in doses of from half a grain to a grain twice or three times daily. In general, in these cases, opium agrees with the patient, and the tongue remains moist, and the digestion unimpaired, under its use. In addition to these remedies, the patient is to avoid all severe exertion, whether mental or physical; and he should be kept as free as possible from all causes of anxiety, his mind being agreeably occupied by some light employments which do not require any considerable effort of attention. Courses of mercury, and even a single dose of mercury, are likely to be injurious, as is the case also with antimony, and other diaphoretics, and with drastic purgatives.

In these cases, also, in which the phosphate of lime is deposited by the urine in the form of an impalpable powder, with little or no increase of the mucous secretion, vegetable or mineral acids may be exhibited, combined with other tonics, or with such remedies as may seem best calculated, according to the peculiar circumstances of the individual case, to improve the general health.

Much more may be done in those cases in which the phosphate

of lime is deposited in consequence of a ropy mucous secretion from the mucous membrane of the bladder. Here you are, in the first instance, to endeavour to remove the cause on which the secretion depends; namely, the chronic inflammation of the membrane. I must refer you here to the observations which I made in one of my former lectures, briefly recapitulating, however, what I then said on the subject. Bleeding not only does not tend to diminish the inflammation, but is actually injurious. The first thing to be done is to discover the cause of the inflammation, and to remove it if possible. It may depend on stricture of the urethra, and may be relieved immediately on the stricture being dilated with a bougie. It may depend on a partial retention of urine in the bladder, in consequence of an enlargement of the prostate gland. The bladder must then be emptied artificially by the introduction of a gum catheter once, or twice, or three times daily. It is seldom advisable in these cases to keep the catheter constantly retained in the bladder, for then the catheter becomes in itself a source of irritation, keeping up the inflammation of the bladder, and adding to the cause on which the deposition of the phosphate of lime depends. This effect of the catheter is clearly indicated by the fact that when it has been for some time retained in the bladder, the extremity of it which was in contact with the mucous membrane, is found to be encrusted with a layer of the phosphate of lime. Perfect rest in the horizontal posture, opiate clysters or suppositories, opium, extract of henbane, or lettuce given by the mouth, will be useful also. The exhibition of the decoction of the root of the pareira brava is, in many instances, productive of excellent effects. It has a remarkable influence over the secretion of the ropy alkaline mucus. Injections into the bladder of warm water, and even of a weak solution of nitric acid, are sometimes useful; but of the cases in which these last remedies are to be recommended, I shall speak to you more particularly in a future lecture.

Where these two diseases, namely, the secretion of the triple phosphate of ammonia and magnesia by the kidneys, and of the

phosphate of lime by the bladder, are coexistent, (and this, as I have already explained, is a very common occurrence), you must combine the two modes of practice which I have just described, with each other. They are quite compatible; and in fact, there are very few of the remedies which are useful in the one case, which are not also useful in the other.

Besides those which have been already described, you will occasionally meet with a deposit from the urine, consisting of the lithic-acid sand and the triple phosphate, blended together in various proportions. The quantity of these mixed deposits is sometimes enormous. A lady who laboured under some aggravated hysterical disorders used to void as much as would fill a table spoon, or even more, in twenty-four hours. In other cases you will find a patient voiding sometimes the pure lithic acid, and at other times the pure triple phosphate. The treatment of such cases is very perplexing. If one disease be already predominant, it may be attended to, to the exclusion of the other. If neither be predominant, you can proceed on no better principle than that of allowing the urinary disease to take its course, while you use your endeavour to improve the general health, which in such cases is always much deranged.

Dr. Prout has described an order of cases, in which the urine deposits the lithate of soda in masses of sufficient size to block up the urethra, and occasion considerable difficulty in voiding the urine. The lithate of soda is the salt which forms gouty secretions; and the cases alluded to were supposed to have occurred in persons of gouty constitution. For further information on this subject, as well as for a more ample history of the pathology and treatment of urinary deposits generally, I must refer you to Dr. Prout's elaborate and profound 'Treatise on Stomach and Urinary Diseases.'

LECTURE X.

RENAL CALCULI.

I SHALL now call your attention to those larger concretions which are formed, and usually retained, during a longer or shorter period of time, in the kidneys, and which are therefore denominated renal calculi. Some of these are of frequent, and others are of rare, occurrence.

1. The most common variety is that which is composed of pure lithic acid. These are generally of a compact texture, laminated internally, and of a light-brown colour. In other respects they present very different characters in different cases. One person will void one every now and then of an oval shape, varying from the size of a pea to that of a horse-bean, tolerably smooth on the surface. Another will void several at a time, perfectly spherical, generally smooth on the surface, but occasionally rough and irregular. Another will void several at a time, from the size of a pin's head to that of a hempseed, or even of a pea. This happens especially after the middle period of life, and in these the disposition to form calculi of this kind may continue for a great length of time, even for years. Dr. Prout regards this as 'a dangerous state of disease, not only on account of the constant liability of the patient to the formation of renal or vesical calculi, which everything conspires to render probable, but on account of the danger which there is of suddenly checking the secretion of lithic acid, which is apt to be followed by great derangement of the general health.' I have, however, known a patient to continue to void calculi of this kind in large numbers for many successive

years, without the general health being materially deranged, and to die at a very advanced age at last.

Dr. Prout is led to believe that the lithic acid forming a calculus of this kind is secreted by one of the mammillary processes of the kidney in a semifluid state; that it afterwards becomes hard, the semifluid mass contracting in bulk as the hardening process proceeds. In Dr. William Hunter's Museum, which was formerly in Windmill Street, but which is now in Glasgow, there are several interesting preparations illustrative of this point in pathology. In some of them the mammillary processes having been longitudinally divided, the tubuli uriniferi are seen blocked up with calculous matter; and in one of them, the development of the calculus being farther advanced, it is seen partly imbedded in the apex of the mammillary process and partly projecting into the infundibulum. These preparations go far towards confirming Dr. Prout's doctrine, as we cannot well suppose the calculous matter in the tubuli to be in an actually solid state.

Lithic-acid calculi may be generated in the kidney in persons of any age, but they are much more common in those who have passed the middle period of life than in younger persons. We meet with them most frequently in those who have led luxurious and indolent lives, and who previously have been subject to deposits of lithate of ammonia or of lithic-acid sand in the urine. It is this class of individuals that is especially liable to gout, and there is an evident connection between these two diseases. A patient may have been in the habit of voiding lithic-acid calculi; he becomes affected with the gout, and the formation of the calculi ceases. In a few cases the two diseases go on together. But I do not remember an instance of a gouty patient who was troubled with the gouty concretions, commonly called chalk-stones, being also troubled with lithic-acid calculi. These gouty concretions are composed of lithic acid combined with soda; and if the lithic acid be secreted into the joints it is less probable that it will be secreted from the kidneys. Some persons, as I have already mentioned, after the middle period of life, void an immense number of this

kind of lithic-acid calculi: I am almost afraid to say how many I have known to be passed by one individual—probably several hundred, of various sizes.

2. The renal calculi next in order of frequency are those composed of the oxalate of lime. These are usually of a dark colour, of an irregular shape, with a number of small protuberances on the surface, presenting somewhat of the appearance of a mulberry, and hence denominated *mulberry calculi.*

Calculi of this description are much more rare than those composed of the lithic acid. It is not merely that the disposition to form them exists in fewer individuals, but that where it does exist they are not generated in the same numbers as the lithic-acid calculi. A patient may void one of these calculi and never void another; or he may void a second after the lapse of many years. In one instance, however, on examining a body after death, I discovered as many as five or six calculi of oxalate of lime in one kidney. In this case there was extensive suppuration and complete disorganisation of the glandular structure of the kidney, and this local disease was the immediate cause of death.

The researches of Dr. Prout have led him to believe that the oxalate-of-lime calculus is not generated in a perfectly healthy kidney, and that two conditions are necessary to its formation: the first, that the oxalic acid should exist in the system, and be secreted with the urine; the second, that lime, in some shape or another (that is, the phosphate or carbonate), should be furnished by the mucous membrane of the infundibulum. According to my experience, disorganisation of the kidney occurs in a much greater proportion of cases of calculus composed of the oxalate of lime than of those of calculus composed of lithic acid. I formerly believed that this arose from the oxalate-of-lime calculus being especially irritating to the parts with which it lay in contact; but since I have been made acquainted with Dr. Prout's observations on the subject, I cannot but suspect that I mistook the effect for the cause, and that the existence of the diseased kidney gives rise to

the calculus, rather than that of the calculus to the disease of kidney.*

3. The triple phosphate of ammonia and magnesia is sometimes deposited in the kidney; but I have known only one instance of a renal calculus being entirely composed of this substance, and I conclude, therefore, that this is a very rare occurrence. But it very frequently happens, where a calculus has been lodged in the kidney for a considerable time, that the triple phosphate constitutes its external layer, while the nucleus is either lithic acid or oxalate of lime. How this happens will be explained hereafter, when we consider the subject of calculi of the bladder.

4. Calculi, composed of phosphate of lime, are occasionally formed in a diseased kidney, probably not from the urine, but from the other secretions of the affected organ. In the Museum of St. George's Hospital there are two kidneys, taken from the same subject, completely filled with calculi of this description, the glandular structure having almost wholly disappeared. A gentleman voided a small renal calculus composed of the oxalate of lime. Soon afterwards, it was evident that he had disease of the kidney, and in the course of another year he voided another calculus, composed of the phosphate of lime. He ultimately died of extensive disease of the kidney.

We are indebted to Dr. Prout for the explanation of the origin of the renal calculus of phosphate of lime. All that I have seen of these cases satisfies me that his views are correct; but it will be sufficient for me to refer to a very interesting case recorded by Dr. Prout himself. He examined the body of a gentleman who died of extensive disease of the kidneys. He found in each of them large deposits of calculous matter; some contained in natural cavities, to which the *urine had access*; others in cysts, which were the products of disease, and to which the *urine had not access*. The former of these deposits consisted of the phosphate

* The oxalate of lime, however, is not in all cases formed in the manner just stated. Mr Cross, in his treatise on Calculous Disorders, describes a case in which the crystals of this salt were detected in the tubuli uriniferi.

and carbonate of lime, with an admixture of the triple phosphate of ammonia and magnesia, while the latter consisted of the phosphate and carbonate of lime only.

It is worthy of notice, that the phosphate of lime constitutes the earthy matter deposited in consequence of disease in other structures, as in the arteries, the lymphatic glands, the valves of the heart, the lungs, the dura mater, and sometimes even in the uterus.

Renal calculi composed of the phosphate of lime are generally of an irregular shape, rough on the surface, of a hard but brittle texture. In a former lecture, however, I have mentioned a case in which phosphate of lime generated in the kidney assumed the form of a paste, which descended into the bladder, blocking up the ureter by which it passed.

5. The formation of a renal calculus, composed of the cystic oxide, is a very rare occurrence. I have nothing to say respecting it from my own experience. For what little is known on the subject I refer you to Dr. Prout's treatise.

The late Mr. Earle published a paper, in the Medico-Chirurgical Transactions, in which he endeavours to show that the formation of renal calculi may frequently be traced to a local injury affecting the loins and kidney. I would advise you to read the paper itself, which contains much interesting information. The only observations which I have to offer on the subject of it at present are those which follow:—

First. Where a disposition to form calculi exists, a mechanical injury may (I doubt not) determine the disease to one kidney rather than to the other; but this disposition is so manifestly connected with a peculiar state of the system, and peculiar habits of life (especially in cases of lithic-acid calculi), that we seem to be scarcely justified in regarding it as arising altogether from the agency of a local cause.

Secondly. It is not improbable that, in some cases in which a mechanical injury has preceded the formation of calculi in the kidney, the first effect of it has been to occasion disorganisation of

the glandular structure, and abscess; and that the calculi generated under these circumstances have been composed of the phosphate of lime, derived, not from the natural secretion of the urine, but from the morbid secretions of the diseased part; and corresponding, as I have just explained, to the concretions of the same kind which are met with in other diseased textures.

Dr. Prout describes the formation of a lithic-acid calculus in the kidney to be, in many instances, preceded by a disordered state of the general health, bearing a close resemblance to what occurs in gout, and attended with a scanty secretion of high-coloured urine. That the lithic acid, while in the circulation, should act as a *materies morbi*, and that the symptoms to which it gives rise should be relieved as soon as the poison which produces them is expelled from the system, is probable enough. It must be owned, however, that both this and the calculus of oxalate of lime are frequently generated in the kidney without any premonitory symptoms of sufficient consequence to attract the patient's notice, and it even may be that he does not suspect that he labours under any kind of disease, until he finds a small calculus expelled with the urine. At other times, however, the presence of a calculus in the kidney is indicated by a pain in the corresponding loin; extending from thence downwards towards the groin and testicle, accompanied with a sense of weight in the loins, and occasionally even with external tenderness. After exercise the urine is tinged with blood; and the functions of the stomach are liable to be deranged, with sickness and vomiting. But all these symptoms are subject to great variety. Sometimes the pain is trifling, at other times very severe; or there may be much pain one day, and little, or no pain at all, on another. There is, for the most part, more pain where the calculus is associated with a diseased kidney, than where the kidney is otherwise healthy; this being in conformity with a general law of the animal economy, that in cases of disease, the sensibility of the diseased organ is exalted above the natural standard. It is to be presumed also, that the degree of pain may be influenced by the size, and shape, and situation of the calculus;

and that much may also depend on the state of the general health at the time. In some instances the urine is only slightly tinged with blood, depositing it in the form of coffee grounds on particular occasions; while in others the hæmorrhage is considerable, distinct clots of blood being expelled with it from the bladder. It is a rare occurrence, that the urine should never exhibit any appearance of blood; but even this happens sometimes. Lastly, the gastric symptoms, which I have mentioned, seldom show themselves in the early stage of the calculous formation, although they are not uncommon afterwards, as I shall explain presently.

I have said that a calculus may pass down the ureter, and be afterwards expelled from the bladder without the patient being conscious that anything unusual is going on. This, however, can happen only where the calculus is of a very small size, or where the ureter has been dilated by the passage of a larger calculus previously. If a calculus be large enough to distend and stretch the ureter in its passage to the bladder, it occasions intense suffering. At first, the pain is referred to the region of the kidney and the groin. It is often very severe; and in that case attended with sickness and vomiting, prostration of strength, cold extremities, a feeble pulse, and a pallid countenance: in short, the patient is in what is commonly called a state of collapse. These symptoms are followed by pain referred to the inside of the thighs and the testicle; and frequently the testicle is drawn upwards to the groin by a spasmodic contraction of the cremaster muscle. The urine is usually secreted in small quantity, of a high colour, and the bladder being impatient of its contents, the patient is making water at short intervals, with pain referred to the neck of the bladder. No relief from these symptoms is experienced until the calculus has escaped from the lower orifice of the ureter, and entered the bladder; but as soon as this has happened, the patient's tortures (for they truly deserve that appellation) are at an end. The time occupied by the passage of the calculus along the ureter varies in different cases, according to the dimensions and figure of the calculus and the impulse which it receives from the current of urine behind it. Some-

times the calculus may reach the bladder almost immediately; at other times it may be lodged in the ureter for many hours, or even for several days. Where the descent of it is thus protracted, the parts to which the pain is sympathetically referred become tender to the touch, and the testicle not unfrequently is actually inflamed and swollen, the inflammation of it continuing for some time after the cause which produced it has ceased to operate.

The symptoms which attend the descent of a renal calculus into the bladder, are generally sufficiently distinct, so that there is no difficulty in the diagnosis. In some rare cases, however, exactly similar symptoms are produced by the descent of masses of lymph, generated in a diseased kidney, down the ureter. I have given some account of two cases of this kind in former lectures. Gouty irritation of the kidneys and bladder is liable to be mistaken for the passage of a renal calculus, by those who are not very careful in their observations. In these cases the large deposit of red or yellow amorphous sediment which the urine exhibits is in itself sufficient to lead you to suspect the real nature of the disease.

In the majority of cases, a calculus of the kidney finds its way into the bladder soon after its first formation; but in other cases it remains for a considerable time in the kidney, being at last dislodged by some accidental circumstance. For example:—A gentleman somewhat advanced in years, who had observed occasionally that his urine was tinged with blood, was overturned in a carriage in which he was riding with two ladies. It was a large heavy vehicle, which came to the ground with great force, causing those who were in it to be severely jolted. When, after the delay which this necessarily occasioned, he had reached home, he found his bladder much distended, and he experienced a violent desire to void his urine. On his making the attempt, however, no urine flowed, there being evidently a mechanical impediment. He strained and strained again, and at last the impediment gave way. A renal calculus, which seemed to have the form of one of the infundibula of the kidney, was projected with no small degree of force into the chamber-pot, and then the urine flowed in a full

stream. In other cases, a stone, which has been long impacted in the kidney, becomes dislodged in consequence of some changes which take place spontaneously in the affected organ, independently of any mechanical injury.

I have already described the symptoms produced by a calculus retained in the kidney. There are none of these which are altogether peculiar to this disease; and hence, although we may often have reason to entertain a strong suspicion as to the existence of a renal calculus, it is difficult, in these cases, to make a positive diagnosis. The voiding bloody urine, there being at the same time no indications of disease in the bladder or prostate gland, is a more constant symptom than any other, but even this may arise from other causes; as from changes of stricture in the kidney, either of a malignant or non-malignant character; or it may take place without any organic disease, from a mere relaxed state of the vessels.

A calculus which is impacted in the kidney goes on increasing in size in consequence of fresh depositions of calculous matter on its surface. Sometimes it grows so large that the escape of it by the ureter is impossible. It occupies at last the whole of the pelvis of the kidney, extending also into the infundibula, assuming the shape of the parts in which it is large, and bearing some resemblance in its general appearance to a piece of madrepore. In these cases the external layers are generally composed either of the triple phosphate of ammonia and magnesia, or of these mixed with the phosphate of lime, while the nucleus is either lithic acid or oxalate of lime, more frequently the former.

It may happen that the pelvis of the kidney is at last so completely occupied by the calculus, that the flow of the urine into the ureter is considerably impeded. The result is similar to what occurs in other cases of obstruction of the ureter. The urine is accumulated in the infundibula, which become dilated to a large size, forming membranous cysts; while the glandular structure of the organ is expanded, and in a great measure absorbed, from the pressure which is thus exercised upon it. In some cases you find

at last the kidney converted into a large membranous bag, on the surface of which scarcely a vestige of the glandular structure is perceptible, while the interior of it is composed of a number of cells communicating with each other, and all containing urine. In other cases you find the whole kidney wasted, the only remnant of it being a membranous substance adhering to an irregularly formed calculus. Of course, under these circumstances, no secretion of urine can take place from the diseased kidney; but the other kidney supplies its place, and, like a muscle which is called upon to perform double its usual duty, it becomes increased in size in proportion.

Thus you find the kidney in one instance distended into a large bag, and in another wasted and reduced to the smallest dimensions. If you will take the trouble to consider what must happen to a kidney before it can become thus wasted, you will, I doubt not, agree with me in the opinion that these two different conditions belong to the same series of changes. The urine is collected in the pelvis and infundibula; the glandular structure becomes absorbed; and the secretion of urine ceases. Then the urine previously accumulated is absorbed in its turn, and the membranous cyst collapses and contracts, until at last it is no more than a mere capsule, in which the calculus remains imbedded. An enlarged kidney forms a tumour, which can be distinctly felt in the abdomen of a thin person. There is reason to believe that tumours having this origin occasionally disappear, and what I have just mentioned may serve to explain how this happens.

A calculus lodged in the kidney not unfrequently induces ulceration and suppuration of that organ. It may be, under these circumstances, that the pus escapes with the urine, and passes into the bladder; and this may happen with little or no constitutional disturbance, the symptoms being local, or of such a nature, as to draw the attention of the surgeon to the bladder rather than the kidney. A lady consulted me concerning what was supposed to be an affection of the bladder. She had frequent desire to void the urine; she voided it, of course, in a very small quantity at each

time; she complained of a cutting pain referred to the neck of the bladder; and the urine deposited, what appeared at first to be, a muco-purulent secretion, but which afterwards had all the characters of true pus, like that from an abscess. Things had gone on thus for two or three years, when the patient was attacked by other symptoms, such as indicate the passage of a calculus along the ureter. A large renal calculus (of oxalate of lime) came away, and the original symptoms were relieved. They were not, however, entirely removed, as the urine continued to deposit a very small quantity of pus afterwards. I have alluded to this case, as well as to some others, illustrative of the same fact, recorded by Morgagni, in one of the lectures on diseases of the bladder.

But much greater mischief than that which I have just described sometimes arises from a calculus which has been long impacted in the kidney. The kidney is of a dark colour from excessive vascularity; enlarged in size; softened in its texture; and at last abscesses are formed in its substance. Sometimes the abscesses burst from time to time into the ureter, their contents being then expelled with the urine; but not without causing considerable distress to the patient, both as they enter the bladder and as they pass out of it. At other times, and more frequently, they never burst at all, but are found, when the body is examined after death, deeply imbedded in the glandular structure of the kidney. In a few instances, an abscess, connected with calculi of the kidney, makes its way backwards, presenting itself, and bursting in the loins. Some of you will remember a case of this kind which occurred in this hospital not long since. A woman died, labouring under an abscess in one loin. On examining the body after death, the abscess was traced to the kidney of the same side, manifestly having had its origin in a large collection of irregularly-shaped calculi. In the Memoirs of the French Academy of Surgery, you will find a paper, in which the author describes two cases of renal abscess which had burst in the loins, in each of which he succeeded in extracting some calculi through the orifice of the abscess. In one of them, after the removal of the calculi, the abscess healed,

and the cure was complete. In the other, a fistula remained ever afterwards; in all probability in consequence of some calculi being still lodged in the kidney, at the bottom of the abscess. Some of the old surgeons have spoken of an operation by excision, for the extraction of calculi from the kidneys. The proposal is absurd and dangerous, if made with a reference to ordinary cases of renal calculi, where no abscess exists. But nephrotomy (as it has been termed) may be practicable where nature, by the formation of an abscess, has pointed out the exact situation of the calculi, so that they may be felt with a probe.

The condition of the kidneys, in the cases which I have just described, is very similar to that of which I gave some account in the fifth lecture, and it is marked by a similar train of symptoms. The symptoms vary in degree according to the extent of the local mischief, and the susceptibility of the constitution. Sometimes many years elapse before they assume any formidable character; and I have already given you the history of a case in which the patient had suffered from calculi impacted in the kidney during a period of at least ten years, and then died of another quite independent disease.

The treatment of renal calculi next demands our attention; but what I have to say on the subject may be comprised in a few words.

You will frequently be consulted by persons who are voiding a great number of lithic-acid calculi in succession. Those already formed cannot be dissolved. The best thing that can happen is that they should pass along the canal of the ureter into the bladder, and then out of the bladder by the urethra. But you may do much towards preventing new calculi being generated. The remedies to be employed are similar to those which I have already mentioned as applicable to cases in which the urine deposits the lithic-acid sand. Purgatives and alkalies may be administered, and alterative doses of colchicum, combined with small doses of

mercury and diaphoretics, where there is a disposition to gout. Attention to diet and mode of life are even of more importance than medicine. But it is needless for me to say more on the subject. I refer you to the observations which I made in the last lecture.

As to the oxalate of lime, or mulberry calculus, we can do little, probably nothing, in the way of prevention. Fortunately this defect in our art is of less importance, as the formation of this kind of calculus is much less likely to recur than that of the lithic-acid calculus.

The existence of the phosphate of lime calculus in the kidney always indicates disease of that organ; probably an abscess in it. Such cases are little under the control of remedies. However, we cannot be wrong in having recourse to the same treatment as where the triple phosphate or phosphate of lime is deposited by the urine in the bladder.

The passage of a renal calculus from the kidney to the bladder is a natural process, over which we have but little dominion. Where the pain is unusually intense, opium may be administered with advantage, but it must be given in large quantity. The patient may also use the warm bath, remaining in it an hour, or even longer. These remedies, however, only tend to the diminution of suffering. Probably drinking plentifully of diluting liquors may be useful, by causing such a rapid flow of urine as will assist in the propulsion of the calculus along the ureter. I have sometimes thought that the patient has derived benefit from the exhibition of an active purgative; for example, a dose of senna, with sulphate of magnesia and tincture of jalap. Dr. Prout recommends the application of ice to the loin, as affording some relief from the intense pain which the calculus in the ureter sometimes produces.

If there be symptoms which lead you to suspect that a stone is lodged in the kidney, it is of course desirable that it should, if possible, be made to pass into the ureter, before it has attained such a size as to be incapable of being conveyed along that canal into the bladder. Horse exercise, especially hard trotting, in such

a case generally produces bloody urine. This shows that the calculus is made to undergo some change of position, and whatever produces this effect is, of course, favourable to its escape from the kidney. It is reasonable to suppose, that medicines which occasion a more abundant flow of urine, combined with diluting drinks, may also be useful under these circumstances. Where a calculus retained in the kidney produces considerable pain in the loins and neighbouring parts, the patient will sometimes derive benefit from local blood-letting, by cupping, or by leeches, and at other times from the application of the belladonna plaster. You may also employ setons and issues in the loins. According to my experience, however, the last-mentioned remedies are seldom very useful, except in those cases in which disease in the kidneys, and especially abscess of the kidney, has taken place as a consequence of the lodgment of the calculus. That they are sometimes eminently useful, under these last-mentioned circumstances, I cannot doubt. I have at this moment a patient under my care, who occasionally voids small calculi from the kidney, labouring, at the same time, under pain in the region of the kidney, with a purulent deposit from the urine; and who has derived marked benefit from a large issue, made with caustic, in the loin to which the pain is referred.

Those extreme cases, in which abscess of the kidney has no means of discharging its contents, and, in consequence, produces symptoms of general depression of the system, with a weakened circulation, and a languor of body, and listlessness of mind, are, I fear, but little under the dominion of our art. We must support the patient by stimulants and tonics, and by making as little demand upon his powers as possible; but, for the most part, we strive in vain against his destiny; and he sooner or later falls a victim to the disease.

Hitherto I have spoken of calculi as being either lodged in the kidney, or as passing from thence to the bladder. But a calculus may be of such a size as to be stopped in its passage to the bladder, and retained in the ureter. It might be supposed, that, under

these circumstances, the ureter would become more and more dilated, and, at last, burst, as the urethra bursts behind a stricture. I cannot say that this never happens; and, indeed, Morgagni quotes a case from another writer, in which there is reason to believe that such an event actually occurred. However, this is not the constant order of events, as the following case will prove:—I attended it many years ago with Mr. Merriman, of Kensington; and Mr. Merriman, jun., has lately sent me some notes respecting it. A gentleman, 64 years of age, who had been subject to the formation of renal calculi, which had afterwards come away by the urethra, was seized with one of his usual attacks, indicating that a calculus had escaped from the kidney. Instead, however, of terminating in the usual manner, the pain continued unaltered, and he ceased to void his urine. On the supposition that there might be urine in the bladder, the catheter was introduced several times, but no urine flowed. The patient became comatose, and died in a fit of convulsions, eleven or twelve days after the commencement of the attack. On examining the body after death, no urine was found in the bladder. In one kidney there were several calculi: there were none in the other. In the ureter belonging to the latter, and in the upper part of that canal, there was a calculus, as it were, impacted, of about the size of a horse-bean. It appeared, therefore, that the circumstance of one ureter being completely obstructed by a calculus, had caused a suppression of the secretion of urine in both kidneys.

A case, in one respect more remarkable, occurred under the observation of my friend Mr. Travers. A patient died, having each ureter, where it arises from the pelvis of the kidney, completely obstructed by a calculus. The consequence of this double obstruction had been the same with that of the single obstruction in the case last mentioned—namely an entire suppression of the secretion of urine. In the lecture on the chronic enlargement of the prostate gland, I have referred to some cases in which obstruction of the ureter from other causes produced the same effect.

A renal calculus, which is small enough to make its way down the ureter into the bladder, is, in the great majority of cases, also small enough to enter the inner orifice of the urethra, being then expelled by the action of the bladder and the pressure of the urine behind. In some instances it meets with an obstruction to its passage along the urethra. The most usual seat of such obstruction is immediately behind the glands, where in some individuals, there is a natural narrowness of the urethra. When lodged in this situation it may usually be removed with the assistance of a small forceps, or, if necessary, the narrow part may be dilated by means of a straight bistoury. In some cases of stricture of the urethra a small calculus has been found impacted behind the stricture, causing a retention of urine. In other cases, a calculus, having arrived at the membranous part of the urethra, has been prevented passing further, although there was no stricture, perhaps from the position of it being somewhat changed from what it was when it first escaped from the bladder. Under these circumstances the safest mode of proceeding will be to make an incision into the urethra, by which the calculus may be extracted. I had a case under my care in which two calculi had been lodged in the membranous part of the urethra for two or three years, the urine flowing over them. At last they had produced a complete retention of urine, and this not being relieved, the urethra gave way behind the obstruction; and when the patient was admitted into the hospital the perineum and scrotum were completely infiltrated with urine, and gangrenous to a great extent. I made an incision in the perineum, and removed two calculi, one of them as large as a walnut. Unfortunately, the patient had too long delayed to apply for assistance; destruction of the soft parts had taken place to a great extent, and the case terminated unfavourably.

LECTURE XI.

HISTORY AND SYMPTOMS OF CALCULI OF THE BLADDER.

ANY solid body which is retained in the bladder for a certain time is liable to have calculous matter deposited on it. Thus a calculus is generated, which increases in size more or less rapidly according to the composition of the urine.

The most common origin of a calculus of the bladder is a calculus which has been formed in the kidney, which has descended by the ureter, and which is either too large to be voided by the urethra, or which is prevented entering the urethra by the projection of an enlarged prostate gland.

In some instances the nucleus is formed by a foreign body, which has been accidentally introduced into the bladder. The late Mr. Wilson removed a stone from the bladder of a female, and on sawing it through, discovered a common hazel-nut in its centre. Mr. Wilson gave a portion of the stone, with the corresponding portion of the nucleus, to the late Mr. Heaviside, at the sale of whose museum I purchased it, with the rest of his collection of calculi; and thus you have the opportunity of seeing this singular specimen. A poor man, a gardener in the country, laboured under a stricture of the urethra. Occasionally he suffered from a retention of urine. Being an ingenious fellow, he discovered that he could relieve himself on these emergencies by introducing a flower-stalk through the urethra, into the bladder, using it as a bougie. In an evil hour it happened that the extremity of the flower-stalk was broken off, and lodged in the bladder. The consequence was, that it became encrusted with calculous matter, forming the nucleus of a stone. Some time afterwards, he was admitted into

our hospital. Sir Everard Home performed on him the operation of lithotomy. He extracted a considerable oblong calculus, which lay partly in the urethra and partly in the bladder; and, on examining it, the flower-stalk was discovered in its centre.—I removed a calculus from a patient in this hospital which had been formed round a portion of an elastic gum catheter that had been broken off in the bladder. A thoughtless young man introduced a piece of wax into his urethra, and contrived to pass it up into the bladder. Two years afterwards I performed on him the operation of lithotomy, and removed a calculus which is preserved in the museum of this hospital, having the piece of wax for a nucleus. I assisted Mr. Keate in an operation in which he removed a cylindrical piece of sealing-wax, several inches long, from the bladder. This was done soon after the sealing-wax had been introduced. If the operation had been deferred for some time, of course the sealing-wax would have become encrusted with calculous matter. In performing the operation of lithotomy on a lady twenty-five years of age, I found a piece of iron wire, like a knitting needle, but with a sharp point, on which a mass of calculous matter had been deposited. It lay across the bladder, with the extremities fixed in the mucous membrane. It was between eight and nine inches in length, and was removed with some difficulty.

In the year 1840 I was consulted with Mr. North respecting a young lady, labouring under very aggravated symptoms of calculus of the bladder. The existence of the calculus having been ascertained, I proceeded to extract it by an operation; the steps of which I shall describe hereafter. On examining the bladder with the finger, previously to the introduction of the forceps, I ascertained that the calculus was adherent to it at the fundus. However, I seized it with the forceps, and, with the application of a moderate degree of force, was enabled to extract it, though not without it having been broken into several pieces. These fragments were found to consist chiefly of the mixed phosphates; but among them were a small portion of bone of an irregular shape, and two imperfectly formed human teeth. If you refer to the 10th volume of

the 'Medico-Chirurgical Transactions,' you will find a case and dissection recorded by Dr. Phillips, which fully explains the nature of the case in question. The teeth and bone, being the result of an original malformation of the ovarium, had become attached to the mucous membrane of the bladder, and formed the nucleus on which the calculous matter had been deposited. A similar case occurred in the practice of Mr. Warner, and is described in the 49th volume of the 'Philosophical Transactions.'

The museum of this hospital affords two examples of calculous matter deposited on hairs. The calculi are numerous, of a peculiar oblong figure, from one-third of an inch to an inch in length, with the hairs lying longitudinally in them. They are composed chiefly, if not entirely, of the phosphate of lime. One of the patients from whom these were taken was a young married lady, attended first by Mr. Wilson of Manchester, and afterwards by myself; and in her the origin of them seemed to be from a small congenital ovarian cyst communicating with the bladder. The other patient was an elderly lady, in whom there was no reason to believe that any ovarian disease existed. We know that hairs are occasionally found in other cysts besides those of the ovarium, and they may in this last-mentioned case have been formed in some such cyst of the kidney. I attended a gentleman who laboured under a calculus of the bladder; also under disease of the kidneys, of which last disease he died; and in whose urine I every now and then detected some very minute hairs, which I suspected to have been of renal origin. Unfortunately the body was not examined after death.

Calculi of the bladder differ very much in their appearance and other sensible properties; they differ very much also in their chemical composition. Of late years they have been made the subject of repeated and minute analysis. These investigations, so important to human nature, and so interesting to the members of our profession, were begun by the late Dr. Wollaston. He was followed by several other chemists; but those who, after him, have contributed most to the advancement of our knowledge of the

subject, are Mr. Brande, Dr. Marcet, Dr. Prout, Dr. Henry, and Dr. Yelloly. I shall present you with a brief summary of the observations which these distinguished chemists have offered to the world as the result of their researches.

The substances which enter into the composition of calculi of the bladder are the following:—

1. Lithic acid. These calculi are generally of an oval form, and slightly flattened; of a brownish-red colour, approaching to that of mahogany; rather smooth on the surface, but not polished, except occasionally from friction, when there are two or more calculi in the same bladder. If broken, the lithic-acid calculi split in concentric laminæ.

2. Oxalate of lime. Calculi of this kind are also distinguished by the appellation of *mulberry*. These are usually of a dark-brown colour, approaching to black; rough and tuberculated on the surface, very hard, and imperfectly laminated.

3. The triple phosphate of ammonia and magnesia. This salt forms a fragile calculus, which, when broken, does not, like the lithic-acid calculus, split into concentric laminæ. The surface of it is uneven, covered with minute crystals.

4. Phosphate of lime. Calculi composed of this substance, unmixed with other calculous matter, are rarely found in the bladder; and when they are, there is reason to suspect, from Dr. Prout's observations, that they have their origin in the secretions of the bladder itself, and not in the urine. These calculi are of a pale-brown colour, and of a laminated structure.

5. Although it is rarely that we find a bladder-calculus composed altogether of phosphate of lime, we frequently find this salt existing in combination with the triple phosphate of ammonia and magnesia. This mixed calculus is of a white colour; friable; not unlike a mass of chalk in appearance; not in general laminated. It melts into a vitreous substance when exposed to heat in the flame of a blowpipe: and hence it has received the name of the fusible calculus. Neither of the two salts, of which it is composed, (that is, neither the triple phosphate, nor the phosphate of lime,)

melt in this manner when exposed to heat singly, although they are so easily fused when in combination with each other.

6. Lithate of ammonia. This variety of calculus is of a clay colour; sometimes it is smooth, and at other times tuberculated on its surface: it is composed of concentric layers. Dr. Prout regards it as being almost peculiar to children.

7. Lithate of soda. This is a rare calculus, of a white colour, like the chalk-stones of gout, probably formed where a patient, having a lithic-acid diathesis, has taken large quantities of soda. I was first informed of the existence of this kind of calculus by Dr. Prout. In our collection of calculi you will see a fine specimen of it, with a deposit of pure lithic acid on its surface: probably there is a nucleus of pure lithic acid also.

8. Cystic oxide. This is a very rare kind of calculus: it is of a white colour; and, when broken, it is found (to use Dr. Prout's own words) not to be laminated, but appearing as one mass, confusedly crystallised throughout its substance.

9. Calculi are sometimes composed wholly of carbonate of lime, but these are of very rare occurrence: the carbonate of lime, however, is frequently blended in small quantity with other ingredients.

10. Dr. Marcet has also described a variety of calculus under the name of xanthic oxide; and another under that of the fibrinous calculus.

11. The fibrinous calculus appears to be composed of the fibrine of the blood. I have never met with but one example of it. This was of an oval shape, about the size of a horse-bean, yellow, semi-transparent, not very unlike amber in appearance, but less hard. When dried, it shrunk to a small size, and became, as it were, shrivelled. I found it in the bladder after death, where no disease of the urinary organs had been suspected during life, but where the kidneys were found to have been diseased when the body was examined after death. There can be little doubt that the kidney had secreted albumen with the urine; and if we consider how near fibrine and albumen are to each other in their

chemical composition, we cannot but suspect the fibrinous calculus to be a deposition from albuminous urine. Unfortunately, in this instance, the chemical properties of the urine had not been examined.

In some cases we find a calculus composed throughout of one of the substances, which have been described, nearly pure; but at other times these substances are variously combined with each other. The best mode of examining a calculus is to have it sawn through the centre. We then, in the great majority of the compound calculi, see the different substances disposed in layers, the lithic acid distinct from the oxalate of lime; the oxalate of lime distinct from the triple phosphate, and so on; while in others they are intimately blended together.

It is only when they are divided in the manner which I have mentioned that we can learn the true history of the formation of calculi. As Mr. Brande long ago observed, the centre or nucleus is generally either lithic acid or oxalate of lime. In many cases, the additions to the calculus are of the same chemical composition with the nucleus; in other cases, the lithic acid is deposited on the outside of the oxalate of lime; and more rarely, the oxalate of lime is deposited on the surface of the lithic acid. A calculus of lithic acid, or oxalate of lime, may exist in the bladder, where there is no evident disturbance of the general health. If the general health becomes affected, and the bodily powers of the patient are impaired, either from the irritation excited in the bladder, or from any other cause, the quality of the urine becomes altered, and, in consequence, the subsequent additions to the calculus are formed of the triple phosphate of ammonia and magnesia. When the calculus has existed for some time in the bladder, it frequently happens, and indeed it always happens sooner or later, that the mucous membrane becomes inflamed; and that an adhesive, tenacious mucus is secreted, which contains phosphate of lime; and this, being blended with the triple phosphate, constitutes, as I have already stated, the fusible calculus. Calculi formed in the ducts of the prostate gland, as I shall explain here-

after, are composed of phosphate of lime, pure, or nearly so. But whatever may be the condition of the bladder, it is a very rare occurrence to find a calculus, of any considerable size, composed of pure phosphate of lime, in it. In cases of chronic inflammation of the bladder, the phosphate of lime is deposited by the mucus in small masses, but these nuclei being exposed to the contact of the urine, and the health becoming impaired, as always is the case under these circumstances, the triple phosphate is added to the phosphate of lime, so as to constitute the fusible calculus.

For these latter observations I am indebted to Dr. Prout. He has also furnished us with a knowledge of the following most important and interesting facts in the history of calculous formations. There are but few cases in which the phosphates form the nucleus of a calculus; but being once deposited, they continue to be so, and are not followed by other depositions. The phosphates may succeed the lithic acid, or the oxalate of lime; but neither of these ever succeed the phosphates. If the external surface of a calculus be composed either of the lithic acid, or of the oxalate of lime, you may be certain that there are no phosphates in the interior; whereas if there are the phosphates on the outside, the general rule, to which there are but few exceptions, is, that some other substance lies underneath. When a vesical calculus is sawn into two equal parts, the nucleus is seen in the centre, the calculous matter being deposited equally, or at least symmetrically, on every side. There are, however, exceptions to this rule, and occasionally we see the nucleus near one surface of the calculus, at a considerable distance from the centre. Mr. Cross has explained how this happens. The patient being confined to the recumbent posture, the calculus does not change its place in the bladder, and the fresh deposits take place only on the exposed surface.*

Calculous disorders prevail differently in different classes of society, among individuals of different ages, and in different climates and districts.

* Cross on Urinary Calculi, p. 13.

Among the lower classes, children are much more liable to calculi than adult persons. You know how large a proportion of hospital patients admitted for lithotomy are children. On the other hand, in private practice, that is, among the more affluent classes of society, very few of our patients are children, and the great majority are persons above fifty years of age. Nor are these things of difficult explanation. In most instances the original calculus is composed of lithic acid; that is, there is a lithic-acid nucleus; and in a former lecture I pointed out some circumstances which are likely to make the children of the lower classes, and those who are advanced in life among the higher classes, especially liable to this kind of deposit.

In all classes, persons of a middle age are less frequently affected by calculus in the bladder than those who are younger or older.

Patients with enlarged prostate gland are particularly liable to suffer from calculi of the bladder. The tumour of the enlarged prostate usually prevents the bladder from being emptied without the aid of the catheter. The consequence is, that if a small calculus from the kidney finds its way into the bladder, it cannot escape in the usual manner by the urethra; and that it lies and grows in the bladder. For the same reason, lithic-acid sand, particles of phosphate of lime, or anything else which can act as a nucleus, become, under these circumstances, the foundation of a stone in the bladder. The bladder is like a chamber-pot that is never washed out, and the component parts of the urine are very liable to be deposited in it, whenever there is any kind of nucleus to which they can adhere. Sometimes a diseased prostate gland causes the formation of calculi in the following manner:—The mucous membrane of the bladder becomes inflamed, as a secondary disease. The mucus secreted by it deposits the phosphate of lime in small mortar-like masses, and each of these becomes the nucleus of calculus. In these cases, if you examine the body after death, you find probably a great number of calculi of irregular forms, of a white colour, rough on the surface; none of them being of a large size.

But these irregularly-shaped calculi are capable of being united

with each other, so as to form a single calculus of large dimensions, and of a regular figure. There is a fine specimen of this rare species of calculus in our museum. In the centre there is a congeries of small masses of calculous matter, with interstices between them, which appear as if they had been originally cemented by mucus. On the outside of these is a shell or crust, formed of the mixed phosphates, regularly disposed in concentric layers. The history of the patient from whom this calculus was taken is highly instructive. He consulted me several years ago concerning an enlargement of his prostate gland, which prevented his emptying the bladder by his own efforts. At that time there was no stone, nor any disposition to form one. I instructed him in the use of the catheter, which he introduced two or three times daily, for three or four years, during the whole of which time he suffered comparatively little from his complaint. I always warned him never to leave off the regular introduction of the catheter; telling him, that whenever he did so, besides encountering other evils, he would make himself liable to the formation of a stone in his bladder. At last, in an evil hour, he forgot my admonitions, and listened to some other advice which was given him, that he should lay aside his catheter. At the end of a year from this time I was again called to see him. The urine was now depositing the usual adhesive mucus; and it was evident, from the small masses of the phosphates which it contained, that he was threatened with a stone in the bladder. I made him return to the use of the catheter: but it was too late. The stone went on increasing in size, until it became such as you now find it to be. It was at last extracted by an operation, from the first effects of which the patient seemed to recover; but he died soon afterwards, manifestly in consequence of disease in the bladder and kidneys; the operation having accelerated, without having actually occasioned, his death.

Women suffer less frequently from calculus in the bladder than men. Their more temperate mode of life accounts, in part at least, for the difference. Much, however, is to be attributed to the more simple construction and greater diameter of the urethra, in con-

sequence of which calculi are voided by them, which would inevitably have been retained in the bladder of the other sex.

Mr. Copland Hutchison has published some observations, which are intended to show that calculus of the bladder is very rare among seafaring persons; much more so than in other classes of society; and hence he is led to conclude, that there is something in the peculiar life of a sailor, which is unfavourable to the production of this disease. However, if you bear in mind what I have just now stated, as to the greater prevalence of the disease among children, and among those who are advanced in life, and recollect also that among sailors there are no children, and very few old men, you will, I conceive, find a sufficient explanation of the fact in question, without resorting to Mr. Hutchison's explanation of it. Besides, it must be very difficult to obtain data sufficiently accurate to enable us to form any positive opinion on such a subject. I have myself operated on officers in the navy, who were affected with stone in the bladder, and in whom the symptoms of the disease began while they were engaged in active service; and I suspect in quite as many cases as were likely to occur in my practice, even supposing the disease were as common in the navy as it is among landsmen. As to the proportion of common sailors who are admitted into the hospital labouring under stone in the bladder, we have no records enabling us to say anything on the subject.

It is observed that calculi of the bladder prevail particularly in certain districts, while in some other districts the disease is extremely rare. I had a patient who resided sometimes near Norwich, and at other times near Bristol; and who, at the former place of his residence, observed the urine to deposit lithic-acid sand, which it never deposited while he was at the latter. This may be attributable, perhaps, in part, to peculiar diet and mode of life. Dr. Prout believes, that hard or impure waters tend to the production of calculi. These explanations, however, are not altogether satisfactory. In some districts in which the disease is unusually prevalent, we find, if I am not much mistaken, that there are not only more calculi with a lithic-acid nucleus, but also more with a

nucleus of oxalate of lime, than in other parts of the country; and it is difficult to understand how the agency of the same cause should produce, in different individuals, calculi of such different chemical composition, and depending on such different states of system. Mr. Cross attributes the greater number of cases of urinary calculi which are met with in Norfolk and Suffolk to the influence of the cold north-east winds which prevail in these counties over the functions of the skin. But if this were the case there ought to be a larger proportion of bronchial and pulmonary affections in Norfolk and Suffolk also, and I am not aware that this is the case. Besides, although the checking of the perspiration may increase the disposition to form lithic acid, I know of no reason for believing that it would increase that to form the oxalate of lime.

A calculus for the most part lies loose in the bladder, being capable of moving, according to the laws of gravity, from one part to the other of the cavity in which it is placed. It is only in a few cases that it is otherwise. Here is a specimen of encysted calculi. The original disease, as you may perceive, was an enlarged prostate gland, such as must have prevented the patient from emptying the bladder. I conclude that the catheter was not used, as it ought to have been, for the purpose of emptying the bladder artificially. The consequence has been, that the patient was continually straining to make water, and that the mucous membrane, by the pressure of the urine, has been caused to protrude in the insterstices between some of the muscular fibres, forming small cells or cysts. Some small calculi, which escaped from the kidney, have found their way into these cysts, and have become lodged or impacted in them.

In the preparation which I now show you, there is a cyst of another kind. The case is in many respects remarkable. I discovered a stone in this gentleman's bladder. But he was advanced in years; and as for the most part he suffered very little inconvenience from the disease; he did not wish to go through any dangerous operation for the sake of obtaining relief: nor did I think it right, considering all the circumstances, to urge him to submit to

it. He went on, in general suffering little or nothing. He was a convivial man, dining a great deal in society, as if he had no ailment. Every now and then, however, he was suddenly seized with the usual symptoms of stone in the bladder, and very severe ones too. He then sent to me: I kept him in the horizontal posture, prescribed him an opiate clyster, and in the course of a few days, sometimes sooner, sometimes later, the attack subsided; he was again at his ease, and enabled to return to his usual habits. I had been occasionally in attendance on him for three or four years, when he was seized with a severe cold, which ended in a pleurisy, of which he died. On examining the body, I found the stone imbedded in a cyst near the fundus of the bladder. The cyst was formed in this case, not by the protrusion of the mucous membrane between the muscular fibres, but by a dilatation of both tunics of the bladder, the muscular as well as the mucous. It was such a receptacle as you would suppose a large calculus, which had long been resident in the bladder, might gradually have made for itself. If you look at the preparation, you will see that the stone was not so closely embraced by the cyst as to prevent it occasionally slipping out of it; and I suspect that this actually happened, and that it was when the stone lay in the cyst that the patient was free from the usual symptoms of calculus, and that his sufferings took place when the stone escaped from it into the general cavity of the bladder.

You will hear not unfrequently of calculi which adhere to the bladder; but you may be assured, nevertheless, that this is a very unfrequent occurrence. Ask all experienced surgeons, and they will tell you what I tell you now, that adhering calculi are rare. It is not very uncommon to find a diseased bladder, a portion of which is incrusted with calculous matter; but that is a very different thing from an adhering calculus, and not likely to be mistaken for a stone in the bladder. It occasionally happens that coagulated lymph is effused from the inflamed mucous membrane of the bladder. The inflamed mucous membrane also secretes that adhesive mucus which contains the phosphate of lime, as I ex-

plained to you formerly. A portion of the phosphate of lime thus produced, mixed probably with some of the triple phosphate from the urine, is deposited on the lymph, and thus the incrustation takes place. It corresponds exactly to the incrustation of the wound of the perineum which occurs after lithotomy, where the operation is followed by the secretion of the same ropy mucus from the bladder.

In many instances you find only a single calculus in the bladder; in others there are two or three calculi. In the latter case they are more or less polished on the surface, from rubbing against each other. Occasionally there is a still greater number of calculi in the same bladder,—ten or twenty, or even thirty or forty. The greater the number of stones, the greater the quantity of friction; and you will see in some of the specimens in the museum how calculi, under these circumstances, are rubbed into the form of irregular polyhedrons.

We have next to consider the symptoms produced by calculi in the male bladder.

The first thing that will strike you, when you come to study the disease in the living person, is, the different degrees of suffering to which different individuals, and even the same individual, in different stages of the disease, are subject.

The symptoms differ; 1st, According to the size of the calculus, the smoothness and roughness of its surface, and its general figure:

2ndly, According to the quality of the urine. Thus, the urine may be unusually acid, or it may be alkaline, and depositing the triple phosphate; and in either case it will be too stimulating for the parts with which it comes in contact, and the symptoms produced by the calculus will be thereby aggravated:

3rdly, According to the state of the bladder. Nothing aggravates the symptoms so much as the existence of inflammation of the mucous membrane. This increases the sensibility of the bladder a hundredfold, and causes a small calculus to produce a much greater quantity of distress and pain than a large one produces under ordinary circumstances.

If the bladder be healthy, a very small calculus produces very trifling, and, indeed, very equivocal symptoms. The patient has the inclination to make water induced by a rather smaller quantity of urine in the bladder than under ordinary circumstances. He has a sense of irritation, scarcely amounting to pain, referred to the neck of the bladder, to the urethra, perhaps to the perineum, after the bladder is empty. In one instance, for many months the patient complained of nothing except an occasional pain, and that but trifling, on the inside of one groin, and of the urine being tinged with blood, after riding on horseback. Bloody urine, after any jolting exercise, is a strong indication of a calculus somewhere, either in the bladder or kidney. Where it arises from other causes once, it arises from this cause twenty times. But this symptom is often wanting in the early stage of the disease, while the calculus is still small, especially where the patient leads an inactive life. A small calculus occasionally falls on the inner orifice of the urethra, while the patient is making water, and thus suddenly impedes or stops the flow of urine. This is one of the most characteristic symptoms of the disease in its origin; but even this either does not exist, or is not observed for a long time.

As the disease advances, and the calculus grows larger, other and more decided symptoms show themselves; which may be thus enumerated:—

1. A very frequent desire to make water; the impulse to do so being sudden and irresistible, and liable to be induced by the smallest change of position.

2. Pain referred to a particular point in the glans penis, at the extremity of the urethra; the pain sometimes being described as a severe yet dull pain; at other times compared to the effect of a hot iron applied to the part—that is, what is called a burning pain. This pain is most severe after making water, and on taking exercise, when the calculus falls suddenly down on the neck of the bladder.

This pain in the glans penis is one of the most marked symptoms of the disease. A child who labours under this disease tells

you of it, not in words, but by his actions. He is always pulling the end of the penis, and pinching it with his fingers, even so as to cause the prepuce to become elongated. You often find his fingers having the cuticle soft and sodden (as if they had been soaked in hot water), from the urine which has been imbibed.

3. The urine is frequently stopped as it flows from the bladder, by the calculus falling against the inner orifice of the urethra.

4. Where there is a calculus even of a moderate size in the bladder, it rarely happens that the urine retains its natural clearness and transparency. A slight cloud is perceptible in it as soon as it begins to cool, and a mucous deposit takes place afterwards.

The disease, in some instances, may exist for many years before any severe symptoms arise. A gentleman had suffered in some degree for upwards of ten years; but the symptoms were so very slight that they did not in the smallest degree interfere with his comfort and usual habits. At the end of that time, being in London, he consulted me respecting them; but he felt so little inconvenience, and the subject so little attracted his attention, that his doing so seemed to be almost a matter of accident. I examined the bladder, and detected in it this enormous calculus, which I now show you. Some months afterwards, his symptoms became much aggravated. He now said that he could bear them no longer, and I removed the stone by the operation of lithotomy.

This case, however, is not in the common course of events. In general the symptoms are progressive, and reach their height, so that the patient becomes a very great sufferer, in the course of two or three years.

At first his general health is unaffected; but at last it begins to suffer, the urine becomes alkalescent or alkaline, and the triple phosphate is deposited on the original calculus. The growth of a calculus composed of the phosphates is much more rapid than that of one composed of the lithic acid. But this is not the only cause of the aggravation of the symptoms which now takes place. The alkaline urine is more stimulating to the bladder than healthy urine, and this is one source of the patient's increased sufferings.

Another reason is, that that state of the general health, which causes the alkaline urine to be secreted by the kidney, is attended with an increased or morbid sensibility of the nervous system generally.

As the disease advances, the continued irritation kept up by the stone induces inflammation of the mucous membrane of the bladder. There is now a still further augmentation of the patient's sufferings. The calculus is rolling about in an inflamed bladder; and you know how the sensibility of every organ in the body is increased by inflammation. The existence of this state of things is indicated by greater pain, and by the desire to make water being almost constant; by the urine being voided offensive to the smell, soon becoming putrid and ammoniacal, and depositing the usual thick, tenacious mucus, streaked with blood. This mucus, as I have already explained to you, leads to the formation of the fusible calculus; and all that I have now stated will enable you to understand that different kinds of calculus are attended with different degrees of suffering. A patient with a simple lithic-acid calculus suffers less than one with a calculus composed externally of the triple phosphate; and the latter less than a patient with a fusible calculus. The oxalate of lime, or mulberry calculus, on the whole, occasions more distress than the lithic-acid calculus; probably on account of the irregularities which so frequently exist on the surface of the former; but it occasions less distress than the calculi composed of the phosphates.

Patients with diseased and enlarged prostate gland do not, in general, suffer more from the disease in the bladder than other individuals. Indeed, I am inclined to believe that, on the whole, they suffer less; probably in consequence of the tumour of the prostate preventing the calculus from falling down on the neck of the bladder. I have, however, seen three cases, in each of which there was a stone in the bladder, complicated, not only with an enlarged but with an ulcerated prostate; and the sufferings of these patients were greater than I had ever before witnessed in persons labouring under the same, or, I might almost say, under any other disease. In two of these cases, the surgeon, who was in atten-

dance, indiscreetly (as I think) performed the operation of lithotomy. One of them died in about five minutes after the operation; the other became immediately comatose, and died in a few hours. The third patient was admitted into our hospital, under the care of the late Mr. Ewbank. The symptoms were precisely similar to those which existed in the two other cases; and Mr. Ewbank, on the result of these cases being stated, very properly determined not to perform an operation, although the man had come into the hospital for the purpose. The poor fellow died in two or three days afterwards; and, on examining the body after death, we found a large stone and an ulcerated prostate, as had been anticipated.

Calculus in the bladder induces frequently an irritable state of the urethra, and thus causes a spasmodic stricture. It induces also increased efforts of the bladder to expel the urine; and thus the muscular coat of the bladder, after a certain time, always becomes increased in thickness.

I have mentioned three cases of calculus in the bladder complicated with ulceration of the prostate gland. But in these cases there was also inflammation of the mucous membrane of the bladder, and, as far as I have seen, such inflammation is never absent where the patient falls a victim to this disease. A moderate degree of inflammation of the mucous membrane may exist for a great length of time without causing irretrievable mischief; and if the calculus be extracted, the inflammation may subside, and the patient may recover perfectly. But if the chronic inflammation becomes aggravated, so as to assume the character of acute inflammation, or even to approach it, the situation of the patient becomes dangerous, and, in fact, almost desperate. The inflammation extends up the ureters to the kidneys, and these last-mentioned organs become diseased in the same manner as in other cases in which inflammation is communicated to them from the mucous membranes. The inflammation also in some instances extends, through the muscular tunic of the bladder, into the atmosphere of loose cellular membrane by which the bladder

is surrounded, and putrid sloughing abscesses are formed in it. I need not enter into a particular history of what occurs where these complications exist. The symptoms of disease in the bladder, or disease in the kidneys, are superadded to those of calculus in the bladder; and it is sufficient for me to refer you to the observations which I made on these subjects in my lectures on the diseases of the bladder and prostate gland.

In some cases, but these are very few in number, the bladder ulcerates, and the stone escapes from its cavity. The bladder exhibited in this preparation is seen to have been ulcerated at its fundus. There were several calculi, and one of them, as you will perceive, had stuck in the ulcerated opening, and lay half in, half out of the bladder. A middle-aged man was admitted into this hospital, in the year 1810, who had laboured under symptoms of calculus in the bladder for the preceding ten years. He had also a fistula in perineo. Sir Everard Home proceeded to extract the calculus by the usual operation. When, however, he had introduced the gorget, he found the calculus (of the size of a walnut) lying in its concave surface, and he removed it with his fingers. No other could be discovered. The patient died on the fourth day after the operation. On examining the body, after death, the bladder was found to be very much contracted, so that it was scarcely capable of containing an ounce of fluid. That which had been its muscular coat had degenerated into a kind of ligamentous substance. The mucous membrane bore marks of having been in a state of inflammation: it was extensively ulcerated; and the ulcer communicated with an ulcerated cavity in the perineum, in which the calculus was lying at the time of the operation. The fistula in perineo had an inner opening in the membranous portion of the urethra. It may be worth while to mention that, in this case, one kidney was reduced to a third of its natural size, and contained a considerable quantity of pus. The ureter on this side had its cavity entirely obliterated: it was nothing more than a ligamentous cord, extending from the kidney to the bladder.

A case came under my observation, in which the patient died

in a very short time after the operation of lithotomy, and in which, after death, a very large abscess was discovered in the pelvis, communicating with the bladder by an ulcerated opening near the prostate gland. In another case, there was an abscess, which occupied nearly the whole pelvis, but having no communication with the bladder. Both of these cases occurred, many years ago, in our hospital, under the care of Sir Everard Home. I mention them, because the patients died so soon after the operation, that it was evident that the abscesses must have existed before it was performed; and that they were the consequence of the disease, and not of the operation. In another case, also, in which the patient died in our hospital, under the care of Mr. Babington, in consequence of a calculus in the bladder, without having undergone the operation, a considerable abscess was discovered in the pelvis. I suspect that such an abscess is not an uncommon occurrence where the patient is allowed to linger and die of the disease.

There is a class of cases, which, being of rare occurrence, do not seem, in the present state of our knowledge, to be of much practical importance, but which I am unwilling to leave altogether unnoticed, especially as they exhibit a phenomenon of some interest in pathology.

In the Transactions of the Royal Society of London for the year 1731, there is a letter from Dr. Lawrence Heister, giving the history of a patient who having, for a considerable time, laboured under the symptoms of calculus in the bladder, began to void by the urethra what had all the appearance of portions of a large calculus, broken down into fragments of various shapes and sizes. The number of these fragments at last amounted to more than two hundred, and now the discharge of the fragments ceased, the symptoms at the same time having subsided, and the patient being restored to perfect health.

In this instance the discharge of the fragments of the calculus was attributed to the use of certain mineral waters; but a case is

recorded by Dr. Prout in which the same thing happened, without the use either of mineral waters or of any other kind of medicine; and Mr. Cross has furnished us with two other cases, the account of which I shall give in his own words:—'I lately obtained from a gentleman, after a ride on horseback, numerous fragments of calculi thus produced' (that is, by knocking against each other); "and in my cabinet there are twenty-two calculi, removed after death from a patient seventy years of age, which are of a very irregular shape, but admit of being so arranged as to form four regular and well-shaped calculi, each of the size of a pigeon's egg, which, with the appearance of the different surfaces, proves that the calculi had broken in the bladder, by knocking against each other under certain movements of the body. The incrusted state of the fractured surfaces proves that the calculi were broken some time before the death of the individual.'

Many years ago I had the opportunity of seeing several calculi, which were evidently fragments of a larger calculus, and which had been voided with the urine by a young lady. I knew no other particulars of the case, nor how it terminated. Some years have also elapsed since Mr. Green and myself were consulted respecting a gentleman who had come to London from the country, with a great number of calculi, of a small size, in the bladder. The day after his arrival he voided several of these, which had the appearance of having been recently broken, probably from the concussion of them one against the other during the journey. A third case came under my observation, which was more remarkable than either of the preceding, and not less fortunate in its result than the one recorded by Heister. A gentleman, who had passed the middle period of life, consulted me concerning an affection of his bladder. I discovered in it what appeared to be a calculus, and not of very small dimensions. I advised him to submit to the operation of lithotomy. The patient, however, was a timid person, and could not make up his mind to follow my recommendation. Having heard of some mineral water which had the reputation of doing good in cases of this description, he went to reside near the spring,

in order that he might give the remedy a trial. How long he drank the water, or whether what I am about to mention occurred while he was still drinking it, or not until after he had ceased to do so, I am not certain. Be that as it may, he began to void, with his urine, broken pieces of calculi, of various shapes and sizes, but generally with one convex and one concave surface, and rough irregular edges, as if the various laminæ of which the calculi were composed had cracked, and then had become separated from each other. After some time, a great number of these fragments having come away, the discharge of them ceased, the patient being, at the same time, relieved from all the symptoms under which he had formerly laboured. He died (as I have been informed), some years afterwards, of another complaint.

I give you these facts without any comment. Future observations are required to enable us to give a satisfactory explanation of them. In the meantime we cannot doubt that the subject is well worthy the attention of pathologists.

LECTURE XII.

CALCULI OF THE BLADDER, CONTINUED.

MANY of the observations which I have hitherto made are applicable to cases of calculi in the female, as well as to those of calculi in the male sex. Others are applicable to the disease in the male sex only, and something is still necessary to complete the history of it in the female.

In women, for reasons which I have already stated, the disease is comparatively rare. It is of course difficult for an individual to form an estimate of the number of cases which occur in women, as compared with those which occur in men; but, judging from what I have seen in my own practice, I should say, that the proportion is as one to fifteen or twenty. In women the disease occasions a frequent desire to make water. There is pain, especially after making water, referred to the extremity of the urethra. The urine is tinged with blood after taking exercise, and it undergoes the changes which cause the deposition of the triple phosphate, and afterwards that of the phosphate of lime, such as I have described in speaking of the disease in the male sex.

DIAGNOSIS OF CALCULUS IN THE MALE BLADDER.

You must, of course, satisfy yourself, in the first instance, whether a calculus actually exists in the bladder. The symptoms, in general, are sufficient for this purpose; but you must not rely on the symptoms only. They will rarely mislead you, but they will sometimes. There *may* be a stone in the bladder, without

the usual symptoms; and there *may* be many of the usual symptoms, without a stone in the bladder. In children, especially, the deposition of lithic-acid sand by the urine will not unfrequently produce, not only pain in the glans, but bloody urine, and all the other symptoms of stone in the bladder. A boy, between four and five years of age, was brought to me who had a constant inclination to make water. He screamed with pain as the urine flowed: he was perpetually squeezing the extremity of the penis between his fingers, as if he referred the pain to that part; and the urine was frequently deeply tinged with blood. I scarcely entertained a doubt that there was a stone in the bladder. I examined the bladder in the way which I shall explain to you presently, but no stone was discovered. I examined it again and again, but still there was no stone. I then inquired more particularly into the child's health in other respects; and the result was, that I was led to prescribe an occasional dose of calomel and rhubarb, with rhubarb and sal polychrest in the intervals; and under this simple plan of treatment all the symptoms disappeared in the course of a few weeks.

Before you venture to give a positive opinion as to the presence of a calculus in the bladder, you must examine the latter by means of an instrument introduced into it by the urethra. Thus the stone may be made cognisable to the senses, and you may know that it exists with as much certainty as if you actually saw it. The instrument in ordinary use for this purpose is that I show you now; an iron sound, having a curve approaching to that of a catheter. The sound ought to be large enough nearly to fill the urethra, but not to stretch it. If it be too large, it is closely embraced by the urethra, and the free motion of it in the bladder, so necessary for detecting a calculus, is prevented. The handle of the sound should be flattened, smooth, and polished, in order that the fingers may be in contact with as many points as possible. In general we introduce the sound while the patient is lying on his back; but sometimes we detect the stone more readily when the patient is in the erect posture. Where the stone is large, the sound strikes it

readily and at once, whether there be, or be not, urine in the bladder; but if the stone be small, it is often difficult to detect it, unless the bladder contains a certain quantity of fluid.

It is difficult to conceive an instrument much worse adapted for the detection of any but a very large calculus, than the sound which has been hitherto in common use. With so large a curve it is impossible to explore the whole of the bladder. The sound which I find it most convenient to use in the majority of cases in the adult is nearly eleven inches in length exclusive of the handle, about three-sixteenths of an inch in diameter; the last three inches of it being bent so as to form nearly, but not exactly, part of a circle, the diameter of which is three inches and a half. It is best to draw off the urine first, and afterwards to inject through the catheter four or five ounces of tepid water into the bladder. The sound, such as I have described, being then introduced, the point of it is easily turned in any direction, so as to explore every part of the bladder. You may shorten the process by using instead of the iron sound a silver catheter, having the same shape, and furnished with a stop-cock. This may be converted into a sound merely by turning the stop-cock. By either of these instruments the examination may be very completely made. Nevertheless, if the symptoms are well marked, it will be unwise of you to conclude that there is no calculus because you do not detect it in the first instance. I have known the most practised surgeons, with the most delicate sense of touch possible, use the sound several times, where the calculus was of a small size, before they felt it so distinctly as to be satisfied of its existence.

In some cases, a calculus which has not been discovered by means of the sound is at once detected by means of the elastic gum catheter. This is an observation made by Sir Everard Home, the correctness of which I have had frequent opportunities of verifying. The gum catheter should be introduced without the iron stilet, while the patient is standing, with his bladder full of urine. You allow the urine to flow through the catheter; and as the last portion of it comes away, the calculus falls down on the extremity

of the instrument, in withdrawing which you feel it quite distinctly. Judging merely from the texture of the gum catheter, I never should have believed it capable of affording such certain evidence of a foreign body in the bladder as I know that it does from experience.

In some instances you may feel a calculus in the bladder with the finger introduced by the rectum. This method of examination is often useful in children, where the stone is above the middle size. It seldom affords you any assistance in the adult, except where the calculus is of extraordinary dimensions.

It is not sufficient that you should ascertain the existence of a calculus; it is of importance also that you should, if possible, learn something as to its size and composition.

You cannot, of course, actually measure or determine, accurately, the size of a calculus which lies concealed in the bladder; but, nevertheless, you may form some notion on the subject which will not be very far from the truth. If the symptoms show that the disease has existed only a short time, and the urine has been, and is, of an acid quality, you may conclude that it is in all probability, composed either of lithic acid or of oxalate of lime. Such calculi are not of rapid growth; and under these circumstances it is not probable that it can be of large dimensions. But if the urine has become alkaline, you will know that the last-deposited layers of the calculus are composed of the phosphates; and calculi of this last description are of more rapid growth, often attaining a considerable size in a moderate space of time. Whatever may be the composition of the calculus, if it has existed for a great number of years, we must presume that it will prove to be a large one. These considerations, however, carry you only to a certain point. You may obtain a more precise knowledge in the following manner:—Measure the calculus, by causing the convex part of the sound to traverse its upper surface from one side of it to the other. When the bladder is full of urine, strike it with the sound, or with the end of the gum catheter. Observe what quantity of force is necessary to push it out of the situation in which it lies;

and, accordingly, as it is displaced easily or with difficulty, so you may form an estimate of its weight and magnitude.

As connected with the diagnosis of calculi in the bladder it is right that I should caution you not to be misled by impostors, who pretend to labour under this disease, although they do not labour under it in reality. This is no uncommon species of deception. Some practise it for the purpose of exciting compassion, and obtaining money from charitable persons; others with a view to make themselves objects of attention and interest in their own families; and in not a few it can be referred to nothing but that perverted state of mind, bordering on insanity, which so frequently accompanies hysterical affections. I saw some pieces of limestone which were actually extracted by means of the forceps, at various times, from the bladder of a female, who, having carved them of a suitable shape, had contrived to introduce them into that organ through the urethra. She was sufficiently skilful to impose for some time on a very well-informed surgeon, as well as on some good-natured and unsuspicious ladies, from whom she levied in consequence considerable pecuniary contributions. In another case several ounces of small pebbles and pieces of brick-bat were produced by a well-educated and accomplished young lady, living in ease and affluence, as having come from her bladder while in the water-closet. I am unwilling to multiply histories of this kind, degrading as they are to human nature. What I have already stated will answer the intended purpose. The mere appearance of the pretended calculi is in general sufficient to unravel the whole mystery. You may have recourse to chemical analysis if further evidence should be required.

TREATMENT OF CALCULI OF THE MALE BLADDER.

When a calculus passes from the kidney into the bladder, the diameter of which is less than that of the urethra, it is usually conveyed into that canal by the impulse of the stream of urine, and thus the patient is relieved of his disease. Sometimes, however, even a very small calculus is prevented escaping in this manner,

in consequence of an enlargement of the prostate gland forming a tumour projecting into the bladder, and making a kind of valve behind the orifice of the urethra. Many persons are liable to the descent of calculi from the kidney for many years, which are always passed with the urine, until they become somewhat advanced in life. Then the prostate becomes enlarged, and the calculi, which descend afterwards, are retained in the bladder.

Under these circumstances, it will be prudent for the patient to void his urine lying on his face, or leaning very much forward, so that what we call the anterior may become the depending part of the bladder. You will observe, that the valve made by the projecting tumour of the prostate is invariably on the posterior part of the bladder—that is, towards the rectum; and if the patient voids his urine in the posture which I have mentioned, the calculi are less likely to be interrupted by it than if he voids it in the usual manner. This, at least, is good in theory, and I may say that it is good in practice also; for a patient of mine, an elderly gentleman, whom I advised to do what I have just mentioned, very soon became relieved of a small stone which had been for some time in the bladder.

A calculus which is of larger diameter than the urethra, of course cannot be voided by that canal. But you may dilate the urethra; and by doing so I have, in a great many instances, enabled the patient to void a calculus which had been for some weeks, or even for some months, in the bladder, and which he certainly could not have voided otherwise. The case here admits of little delay. Every day adds to the bulk of the calculus, and diminishes the chance of success. Introduce a bougie, or a metallic sound, of such a size as the urethra will admit without inflammation being induced. Every day, or every other day, according to circumstances, introduce one a little larger; and thus you may dilate the urethra gradually, until it is a good deal larger than its natural size. The degree of dilatation of which the urethra is capable varies in different cases; but it is generally considerable. When this process has been carried as far as it can be, let the patient drink plentifully

of diluting drinks. It may be worth while even to give some of the compound spirit of juniper, or other diuretic, at the same time; and the calculus will probably, some time or other, be carried, by the current of urine, into the dilated urethra. You may add to the chance of the expulsion of the calculus, by adopting the following method:—Once daily introduce a large bougie into the urethra and bladder, and there let it remain. Then let the patient drink plentifully of barley-water, or toast and water, or weak tea, so that the bladder may be fully distended with urine. When the patient can bear the distension of it no longer, let him place a vessel on a chair, standing and leaning forward over it. On the bougie being withdrawn, the urine will follow it in a full stream, and the calculus may probably accompany it. I learned this mode of treatment from a patient who contrived it for himself, and who in this manner became relieved of three considerable calculi, for which an intelligent and experienced surgeon, in a provincial town, had recommended him to undergo the operation of lithotomy.

If a small calculus cannot be made to pass in the way that I have mentioned, you may extract it from the bladder by means of the urethra forceps.

The invention of this method of extracting small vesical calculi without the aid of cutting instruments deserved to be regarded at the time as one of the greatest achievements of modern surgery. The credit of it belongs to an individual who contributed in a great variety of ways to the improvement of our art. I scarcely need tell you that I mean Sir Astley Cooper. But even he would not have succeeded in attaining the object which he had in view, if he had not been aided by the mechanical talents of Mr. Weiss; who, when the matter was explained to him, contrived the forceps which I now show you. Sir Astley Cooper has recorded his experience on the subject, in two papers published in the eleventh and twelfth volumes of the 'Medico-Chirurgical Transactions;' and to these I may refer you, if you wish to become acquainted with the history of this invention, and of the cases to which it was first applied.

But it was not to be supposed that such a novel operation could be brought at once to a state of perfection. The forceps which Mr. Weiss originally constructed is liable to these objections. It is difficult to explore with it every part of the bladder; and in opening the blades, the neck of the bladder is always painfully dilated. The same thing may be observed respecting another forceps made on my suggestion afterwards. Mr. Weiss has since contrived a kind of forceps on another principle, and which is much better adapted for the intended purpose. A single inspection of it will make you better acquainted with its construction than the most laboured description. You will observe that it is composed of two pieces of steel, one sliding longitudinally in a groove of the other. The extremity which enters the bladder is curved, but not in the manner of a common catheter; the curve being more abrupt, and the curved part considerably shorter. When the forceps is to be opened, the sliding piece is drawn towards the handle of the instrument; and thus the blades, in being separated, are still kept parallel to each other. They are closed by an opposite movement.

As to the mode of seizing a stone and extracting it by means of this forceps I say nothing at present, as the subject will be fully discussed in the lecture on lithotomy. Indeed I would not advise you to have recourse to this method of treatment without being prepared for the other: that is, the forceps should be strong enough to crush a stone which is too large to be extracted entire, and it should be provided with a screw to be used, if required, for that purpose. There is only one exception to this rule, and that is where, in consequence of chronic inflammation of the mucous membrane, a number of small masses of phosphate of lime (the product of the adhesive mucus) have been deposited in the bladder. These are of so soft a consistence that they may be crushed by the mere pressure of the thumb; and if the fixed blade of the forceps be made concave to answer the purpose of a scoop, they may be removed with great facility. In the summer of 1833, an elderly gentleman, labouring under the complication of disease which I have just mentioned, with the addition of an enlargement

of the prostate gland, placed himself under my care. The urine was ammoniacal, filling the chamber with an offensive odour, and depositing a large quantity of adhesive mucus. The desire to make water was incessant, and the act of making it was attended with the greatest suffering. On the introduction of a sound, a large quantity of calculous matter was detected in the bladder. The patient was unable to empty the bladder by his own efforts; there being always a residuum of two or three ounces of urine left in it. In the treatment of the case, I began with drawing off the urine once daily, by means of an elastic gum catheter, washing out the bladder by an injection of tepid water afterwards. I then added a single minim of the concentrated nitric acid to each ounce of the water used for the injection. This local application was attended with excellent results. The mucous secretion became very much diminished in quantity; and the bladder at the same time so much less irritable, that four or five ounces, either of urine or warm water, could be retained in it without much inconvenience. I now proceeded to extract the calculi which it contained, by means of the urethra forceps. None of these were of a large size, but they were very numerous, so that several operations were required, occupying, with the necessary intervals, not less than four or five weeks. At last the whole of them were extracted. The chronic inflammation of the mucous membrane now completely subsided; but as the patient still was unable to empty his bladder, I recommended that he should use the catheter at regular intervals, always injecting some tepid water after he had drawn off his urine. The patient lived in a state of comfort for nearly a year, when, being, as I have already stated, an old man, he died of another complaint.

When I first used the urethra-forceps, and before I was accustomed to the operation of lithotrity, it happened to me several times to draw a calculus through the yielding neck of the bladder, which was too large to be extracted by the urethra afterwards.

Under these circumstances I made an incision on it, in the perineum, or elsewhere, and thus removed it. This is a very simple and safe method of lithotomy, and applicable to a considerable number of cases. I have only one caution to give you respecting it, namely, that you should never incise the urethra where it is enclosed by the scrotum, or immediately in front of it, as the infiltration of even a single drop of urine, which may take place notwithstanding the retention of the gum catheter in the bladder, will probably cause considerable inflammation of the scrotum, and a succession of troublesome abscesses.

Whatever may be the advantage of this method of operating where the calculus is of small dimensions, it is evident that it can be of no avail in other cases. We must resort to other expedients, whenever the calculus is of too large a size to be drawn easily through the neck of the bladder.

It has been observed by chemists, that lithic acid admits of being dissolved by a strong solution of pure or caustic alkali. It has been also observed that calculi composed of the phosphates are acted on by the mineral acids; and it may not unreasonably be entertained as a question, how far those changes, which take place out of the body, may be produced while the calculus is still in the bladder of a living person.

This problem, of the solution of calculi by chemical agents, has occupied the minds of many individuals both in past and present times. It has been proposed by some to administer the menstruum by the mouth, so that it might be conveyed into the urine by the usual channels; and by others to inject it into the bladder, by means of a catheter. This subject is one of great interest, and well deserves our serious and unprejudiced consideration.

I fear that those who have expected by these methods to relieve patients of lithic-acid calculi, have much over-rated the effects of alkaline *lixivia* on them. The fact is, that although alkalies certainly are capable of acting on this kind of calculus, their action, except when employed in a very concentrated form, is so inconsiderable, as to amount to almost nothing. Neither the stomach nor the

bladder is capable of bearing the quantity of alkali which is necessary to the production of the desired effect; and even if they were, it would be impossible to maintain so constant a supply of the alkali as would be necessary to the destruction of a calculus of even moderate dimensions. Mr. Brande, moreover, has observed that the carbonates of potass and soda have no action on lithic acid; that they are incapable of dissolving it; and that, if the pure alkali be taken by the mouth, it never reaches the bladder in this state, but only in that of a carbonate: and here then is an insuperable objection to all attempts to dissolve lithic-acid calculi by means of alkalies taken into the stomach. When there is a lithic acid calculus in the bladder, and the lithic-acid diathesis prevails in the system, the first effect of alkalies taken into the stomach is to render the urine neutral; thus preventing the further increase of the calculus. So far, then, alkalies are useful. But if they be administered in still larger quantity, so as to render the urine alkaline, the phosphates begin to be deposited. The calculus then continues to grow even more rapidly than before; but its composition is altered, and layers of the triple phosphate are deposited on the lithic-acid nucleus. Such is the view of the subject taken by Mr. Brande; and if you read what he has said on the subject in his papers on calculi, you will, if I am not much mistaken, be satisfied that it is well founded.

But you will, not improbably, hear of cases in which it has been supposed that, under the use of alkaline medicines, calculi have come away by the urethra, broken down into fragments; and you will hear of others in which, under the same mode of treatment, the symptoms dependent on the calculus have vanished; and this last-mentioned circumstance has in itself been regarded as a sufficient proof of the calculus having been dissolved, although no calculous matter had ever been discovered in the urine. But none of these cases will stand the test of critical inquiry. I have in a former lecture referred to some remarkable cases, in which calculi seemed to have been actually broken into pieces in the bladder. But however it was that this happened, it is evident that it was

to be attributed to the operation of mechanical causes, and not of chemical solution. In other cases the supposed fragments, instead of being parts of an old stone dissolved, have been actually a new formation—the mischievous result of the indiscreet and unscientific exhibition of alkaline medicines. Such cases, instead of adding to the laurels of surgery, only show how this important and useful art may become a source of evil instead of good, when it falls into the hands of the inconsiderate or ignorant. With respect to the cases of the second order, you will observe, that, when you come to investigate them, you never find that the symptoms have altogether and completely subsided. There has been some diminution of them, but that is all; and various circumstances will explain whatever amendment has taken place. Thus a stone may become encysted, which was not so originally. So it was, probably, in a case, the history of which I related in a former lecture. Another remarkable example of this occurrence presented itself to Sir Astley Cooper and myself. A gentleman, about sixty-six years of years, consulted us concerning a frequent desire to make water, attended with pain and some other symptoms, which a calculus in the bladder might occasion. We had a suspicion that such was his complaint, and had purposed to examine the bladder with a sound. Previously to this being done, however, the symptoms began to subside, so that the patient suffered comparatively little inconvenience from them. About a year and a half afterwards he died of another, and wholly different disease. On examining the body after death, we found at the fundus of the bladder, a cyst formed by the protrusion of the mucous membrane between the muscular fibres; and in this cyst was lodged a calculus of the size of a hazel-nut, of which it seemed impossible to doubt that it had been the cause of all the distress which the patient had suffered formerly. Now let us suppose that, in such a case as this, the existence of the calculus having been ascertained, the patient had gone through a course of alkaline medicines; would it not have been supposed by himself and his friends that the alkalies had produced a cure?—and if the real circumstances had not been disclosed by

a post-mortem examination, would not the case have been handed down, as affording an example of the great influence of alkalies over calculous disorders?

Another circumstance may occasion a considerable abatement of the symptoms of calculus in the bladder; namely, an enlargement of the prostate gland. The more urgent symptoms produced by a calculus arise from its coming in contact with the internal orifice of the urethra. But where the prostate is enlarged, so as to form a tumour projecting into the bladder, this is in great measure prevented. The calculus becomes lodged, as it were, in the hollow behind the tumour, and is thus prevented falling down on the neck of the bladder; and hence it is, if the enlargement of the prostate supervenes on a calculus in the bladder, that the symptoms of the latter disease are often, in no inconsiderable degree, relieved. Sir Everard Home has published an account of two cases, the circumstances of which are, as it would seem, to be explained in this manner. These cases are especially interesting on this account,—that both of them had been published while the patients were yet alive, in proof of the efficacy of solvents. In each of them, the calculi, which were supposed to have been dissolved, were found in the bladder, after death, apparently unaltered. I may mention, as a matter of curiosity, that one of these patients was Sir Everard's own father.

The mineral acids undoubtedly exercise a much greater chemical action on calculi composed of the phosphates, than alkalies do on those which are composed of lithic acid. It is not, indeed, possible to exhibit them by the mouth in such quantity as to render the urine sufficiently acid for the purposes of a solvent; but we have no right to conclude from thence that they may not produce this effect if injected into the bladder by the urethra.

I have already explained the use of injections of a weak solution of nitric acid, in relieving chronic inflammation of the mucous membrane of the bladder. In making further experiments on the subject, I found that where the mucous membrane was not inflamed at all, or inflamed only in a slight degree, the proportion of the

nitric acid might be increased to two minims or two minims and a half of the concentrated acid to an ounce of distilled water, without any ill consequences, or even inconvenience, arising from it. I next endeavoured to ascertain to what extent a solution of this strength was capable of acting on a calculus of the mixed phosphates. The change produced was sufficiently obvious, especially when the solution was made to pass over the calculus in a stream for a considerable time. It gradually diminished in size, and at last began to be broken down into minute fragments. About this time, an elderly gentleman consulted me under the following circumstances:—He had laboured under stricture of the urethra for a great number of years. The stricture had been much neglected; and, at last, had produced the usual consequences—disease of the bladder—that is, chronic inflammation of its mucous membrane, and, probably, disease of the kidney also. The patient had an almost incessant desire to void his urine; every attempt to do so was attended with the most excruciating pain; the urine, at the same time, being highly alkaline, offensive to the smell, depositing a large quantity of viscid mucus, with which were blended small particles of phosphate of lime, resembling mortar. He was drinking lime-water, which some one had advised him to take, with great perseverance, and, the more he drank, the more he suffered, and the more mortar came away. This, he thought, was all as it ought to be; and he expressed himself as patients often do under the same circumstances, saying that, no doubt, it was better that he should get rid of the gravel, and that the lime-water must be doing him good. However, not being so well satisfied on this point as my patient seemed to be, I advised him to leave off the lime-water. The symptoms were immediately altered for the better; but still they were bad enough. The next step was to introduce a catheter, and afterwards a sound, into the bladder. When this was accomplished, which, on account of the contracted state of the urethra, was at first not without some difficulty, I at once detected a calculus. Here, then, was a case of calculus manifestly composed of the phosphates, arising out of a

diseased state of the bladder, and a case in which the danger of any kind of operation would have been so great, that no prudent surgeon would think himself justified in recommending it to the patient. Dr. Prout was consulted at my request, and he agreed with me in thinking, that, under the peculiar circumstances of the case, it was one well fitted for the experiment which I had proposed with the nitric-acid injection.

For this purpose I procured the catheter which I now show you. It is made of the purest gold which can be worked. It has two channels, which are separated from each other by a longitudinal septum running the whole length of the instrument. Each channel terminates by a distinct tube at the handle, and has a separate opening at the other end of the catheter. By means of this instrument, you will observe that a liquid may be injected into the bladder, entering it by one passage, and flowing out of it by the other, so that there may be a current through the bladder, without that organ being inconveniently distended. I had contrived a complicated apparatus for the purpose of making the injection; but I was afterwards led to prefer the simpler contrivance of an elastic gum bottle, having a stop-cock, and an elastic gum tube attached to it. At first I washed out the bladder with some distilled water, to get rid of the mucus which was lodged in it. Then I injected the solution of nitric acid very slowly, using the same liquid over and over again several times. After the operation was performed, the liquid which had been employed as an injection was tested by the addition of a *highly concentrated* solution of pure ammonia; and it was always found, that, if the ammonia was added in a sufficient, but not too large a quantity, the phosphates were precipitated in abundance. The patient suffered no material inconvenience from this operation. It was continued sometimes for fifteen minutes, sometimes for half an hour, and repeated, according to circumstances, once in two, three, or four days. At last, in making water, the patient voided these two small calculi, composed of the phosphate of lime, with a small proportion of the triple phosphate. It was impossible to doubt that they had been acted on, and partly dissolved, by the acid injection, and that they

had, at last, come away by the urethra, in consequence of their having been thus reduced in size. For some time after this occurred, the patient was in a state of comparative ease. He had still symptoms of stricture of the urethra and diseased bladder, but he was free from the more urgent symptoms under which he had laboured formerly. By degrees, however, these symptoms began to recur; and I have no doubt that there was a fresh formation of calculi, produced chiefly, as was the case with the former ones, by the diseased state of the bladder. If he had remained in London, I should probably have been able to have given him some further relief, by repeating and continuing the use of the injection. But he went into the country, where, having been for a long time in a very bad state of general health, he at last died, as I was informed, of some disease not immediately connected with that on account of which I had been consulted.

After the occurrence of this case, I contrived a more complete apparatus for the purpose of making the injection, and endeavoured from time to time, as opportunities occurred, to follow up the investigation. From the experiments which I then made, I felt justified in drawing the following conclusions:—

1. That a calculus, composed externally of the phosphates, may be acted on by this injection so as to become gradually reduced in size, while it is still in the bladder of a living person.

2. That there is reason to believe that small calculi, composed throughout of the mixed phosphates, such as are met with in some cases of diseased prostate gland and bladder, are capable of being entirely dissolved under this mode of treatment, and that it is probable that it may therefore be applied with advantage to some of these cases, in which, from the contracted state of the bladder, or from other circumstances, the extraction of such calculi by means of the urethra-forceps cannot be accomplished.*

* Since these observations were made, Dr. Hoskins of Guernsey has proposed a solution of the nitro-saccharate of lead to be injected into the bladder as a solvent for the earthy phosphates. Being little or not at all stimulating to the mucous membrane, it seems to possess great advantages over the solution of nitric acid, but I have not yet had occasion to make a trial of it.

LECTURE XIII.

OPERATION OF LITHOTOMY.

I PROCEED to describe the method of extracting a calculus by means of an incision of the bladder. This is what is commonly called the operation of lithotomy. I shall draw your attention to the operation in the male sex first, and afterwards to that in the female.

You may make an opening into the bladder at its fundus; and this is what is meant when we speak of the high operation. You may also make the opening at the neck of the bladder. The experience of the great majority of surgeons, from the time of lithotomy having been first practised to the present day, is in favour of the latter method of operating; but as to the exact mode of making the incision at the neck of the bladder, there has been, and still is, a considerable variety of opinion. I shall explain to you what I am led to believe to be the most eligible method of performing the operation; endeavouring to establish, at the same time, the principles on which it is to be conducted; the observance of which will enable you to do all that human means can do towards the safety of your patient.

In order that the object of the operation may be clearly understood by those who have not yet studied the subject, I am accustomed to explain it in the following manner:—

A small calculus may be voided by the urethra, without an operation of any kind. A larger calculus is prevented coming away, because the urethra is too small to receive it. The obvious remedy for this is to dilate the urethra, to make it wider; and if it cannot be sufficiently dilated by the bougie, it must be dilated

by the knife. But it is unnecessary to divide the urethra for this purpose through its whole extent. It is much easier to cut down on the urethra where it lies in the perineum, and dilate the posterior portion of it (which includes what is called the membranous part, and also that which lies imbedded in the prostate gland). The stone may then be extracted through the wound in the perineum, the greater part of the urethra remaining untouched and unhurt.

In performing this operation there are some things to be especially kept in view.

1st, The external incisions are to be made in such a manner as that there may be a sufficient space for the easy extraction of the calculus. Such a space does not exist between the two rami of the pubes, in the upper part of the perineum. Neither will it be obtained by an incision made in a vertical direction, in the line of the raphe of the perineum, unless, indeed, it be carried so low down as to divide the anus and a portion of the rectum. But if the incision be made obliquely, beginning at the raphe of the perineum, and extending laterally between the anus and the tuberosity of the ischium, there will be room, as far as the external parts are concerned, for the extraction of a very large calculus. Such an incision will manifestly answer the intended purpose, at the same time that it is not liable to the objections which may be urged against the incision made in the course of the raphe, and extending into the rectum.

2ndly, The incisions are to be made so as to avoid any considerable and dangerous hæmorrhage. It is idle to say that the occurrence of such a hæmorrhage is a hypothetical evil. Even in a young person, with a small mass of substance in the perineum, there are vessels which may bleed much if divided. But the operation is frequently performed on persons advanced in life, who have a deep perineum, that is, in whom a large mass of soft parts must be divided before the knife can reach the bladder. The vessels of the perineum are in them large in proportion; and an incision made with the utmost care will sometimes divide vessels

which will bleed profusely. On this account, the incisions should not be more extensive than is really necessary; especially in the deep parts of the perineum, where the bleeding vessels are not so readily to be discovered, nor so easily commanded, as they are near the surface. With the same view the incisions should be low down in the perineum, so that there may be as little risk as possible of wounding the artery of the bulb of the urethra; at the same time that care is taken not to carry them close to the ischium, where the trunk of the internal pudic artery is situated, and where its branches are, of course, of a larger size than at a greater distance from their origin.

3rdly, It is, on other accounts, of great consequence that there should be no large incision of the neck of the bladder. The prostate gland is of a firm, dense structure; and when it is divided, the urine passes over the cut surface, without there being any danger of it penetrating into its substance, or into the neighbouring textures. But on the outside of the prostate, and neck of the bladder, is a loose cellular membrane, which, if the urine has access to it, may become infiltrated with it to a very great extent; and which, thus infiltrated, will certainly be rendered the seat of extensive inflammation, sloughing, and abscesses. It is important, therefore, that we should avoid carrying the incision beyond the boundaries of the prostate, into this loose cellular membrane. It is true, that, if the calculus which is to be extracted be beyond a certain magnitude, this cannot be avoided; but it may be avoided otherwise. Not only a small calculus, but one considerably above the average size, may be taken out of the bladder, through a wound which does not extend beyond the limits which I have mentioned; and in many instances where, from the size of the stone, this cannot be accomplished by means of an incision confined to one side of the prostate, the object may be attained by making a double section, and dividing the prostate on both sides.

The dangers attendant on an extensive wound of the neck of the bladder, penetrating beyond the margin of the prostate, are not merely theoretical. As long ago as the year 1810, the case which

I am about to mention first opened my eyes to the ill consequences arising from a communication being made between the cavity of the bladder and the loose cellular membrane in which it is enveloped. I was present at an operation of lithotomy, performed by a very experienced and skilful surgeon. There seemed to be no difficulty in its performance, and the forceps was introduced only once into the bladder. But the bladder (as I suppose) was in a contracted state, and the surgeon, in opening the forceps, observed a resistance, which suddenly gave way, as if a ligature had been broken. In the evening the patient was apparently well; but during the night he had no sleep, and he complained exceedingly of hunger. On the following day, towards the afternoon, his abdomen became a good deal distended, and the pulse rose to 150 in a minute. He was low and desponding; his hands were cold, and his respiration frequent. During the following night (the second from the operation) these symptoms became aggravated. He had still no sleep; the pulse was more rapid and feeble; and on the following morning he died.

It fell to my lot to examine the body after death. In doing so, I found that the mucous membrane and muscular tunic of the bladder had been ruptured for about the extent of three quarters of an inch. The rupture was situated on the left side, just anteriorly to the rectum, and it, of course, extended into the cellular membrane on the outside of the bladder. The cellular membrane in the neighbourhood of the rupture, and for some distance upwards in the course of the ureter, had the appearance of being infiltrated with urine; it was inflamed and sloughy; and at the lower part, close to the bladder, its cells were occupied by a small quantity of pus.

In the year 1816 I met with the following case, which confirmed the suspicions which the preceding case had excited in my mind:— A little boy, about a year old, was admitted into the hospital, labouring under calculus in the bladder. I performed the operation for its extraction, making the incision of the prostate with a common scalpel. Having introduced my finger into the bladder,

I felt a very large calculus, and at the same time found that I had made a very small incision. On this I introduced a probe-pointed bistoury, and dilated the wound, as I thought, sufficiently for the easy extraction of the calculus. On the following day the pulse was rapid; the patient was low and depressed; and from this time he continued to sink, until he died on the third day after the operation. On dissection, I found that the wound at the neck of the bladder had extended beyond the boundaries of the prostate gland. The cellular membrane in the neighbourhood had all the appearance of having been infiltrated with urine. It was in part inflamed, and in part in a state of slough, being converted into a substance resembling wet tow. There was nothing else to account for the patient's death.

Some time after the occurrence of this last case, I had the opportunity of perusing Scarpa's Memoir on the Cutting Gorget, and was gratified to find that the views which I had been led to form corresponded to those of this distinguished surgeon. That these views are correct, I cannot at this moment entertain the smallest doubt. They are supported by other cases which have fallen under my observation, in which the patient manifestly died from inflammation and sloughing of the loose cellular membrane surrounding the prostate and neck of the bladder. If anyone who has had much experience in lithotomy, will look back at the cases which he has met with, in which patients have died after the operation, he will, if I am not much mistaken, find that what I have just mentioned will explain many things which would be otherwise inexplicable; in particular, he will find an easy solution of the great danger which attends the extraction of very large calculi. He will also be enabled to comprehend wherefore it is that patients, on whom the operation is performed with the greatest apparent dexterity and ease, and in the shortest possible space of time, sometimes die in the course of two or three days after the operation; while others, in whom the stone appears to have been extracted with difficulty, recover without any unfavourable symptoms.

I proceed next to explain to you in detail the various steps of

the operation. The first, as I have already stated, is the making an incision into the urethra where it lies in the perineum; the second is the dilating, or dividing that canal where it is surrounded by the prostate. To facilitate the accomplishment of these objects, it is convenient to begin with introducing into the urethra this solid steel instrument, which we call a staff. It is of the figure of a sound; from which, however, it differs: first, in the handle, which, instead of being smooth and polished, is made rough, in order that it may be more firmly and steadily held; secondly, in having a groove, like that of a director, on its convex side. It is, in fact, a director, and intended to answer precisely the same purpose. The staffs sold by the instrument-makers are generally of too small a size. They should be as large as the urethra will easily admit, without being painfully stretched. A large staff is more easily felt in the perineum than a small one, and it admits, of course, of a deeper and wider groove. The groove ought to become gradually shallower just before it terminates at the extremity of the instrument, in order that the point may be neatly rounded off. The edges of the groove ought to be carefully rounded off also. Attention to these circumstances in the construction of the staff, renders its introduction more easy. I generally begin the operation with introducing the staff into the bladder, merely because it is, on the whole, more readily managed when the patient is standing erect, than after he is placed on the table.

The next thing is to secure the patient in a proper posture, with the perineum exposed. About two feet six inches is a convenient height for the table. The patient should be placed on it, lying on his back, supported by pillows, with his shoulders somewhat elevated. He should be directed to grasp the outside of each foot with the hand of the same side; and then the hand and foot are to be bound together by several turns of these bandages, which we call lithotomy garters. If the patient be corpulent, he probably will not be able to grasp his feet, and he must in that case grasp his ankles instead. Besides the lithotomy garters, it is convenient to apply another bandage—the neck strap—which is thrown over the

back of the neck, and passed under each ham. These bandages are not employed with a view to prevent the patient struggling, as persons out of the profession generally suppose, but solely for the purpose already mentioned, namely, to keep him in a convenient posture, with the perineum properly exposed. Thus prepared, the patient is drawn towards the end of the table, with the buttocks rather projecting over it.

Several assistants are required; one to support the patient on each side, holding his feet, hands, and knees, and keeping the lower limbs well asunder; a third to give you the instruments, in the order in which you want them; and a fourth to hold the handle of the staff. It is also convenient, though by no means necessary, to have another assistant, to support the patient's shoulders. Your assistant, who holds the staff, may stand on either side; but it is usual for him to stand on the patient's left side, in order that he may take the handle of the staff in his right hand.

The surgeon himself should be seated on a stool before the patient. He is first to attend to the position of the staff, taking care that it is held nearly perpendicularly; the handle of it being, however, a little inclined towards the patient's right groin. This causes the convexity of the instrument to project slightly on the left side of the perineum.

In the first part of the operation your attention is to be directed to the staff. You are to feel it with your left hand, and the knife, held in your right hand, is to be directed towards it. It is a sure guide; following which, you can never err, even in the deepest perineum. On the other hand, if you lose sight of it, you are cutting in the perineum as it were at random; you divide parts which you ought not to divide; especially you are in danger of carrying your incisions too near to the ramus of the ischium, where the branches of the internal pudic artery are of a larger size than in the centre of the perineum, and therefore more liable to bleed. I have seen some surgeons endeavour to introduce the point of the double-edged scalpel into the groove of the staff at the first incision. But I caution you against this, as a great error in the

operation; except, indeed, it be in the case of a young and very lean subject. Where there is any quantity of fat in the perineum, or anything even distantly approaching to what we call a deep perineum, if you attempt to cut at once into the groove of the staff, the result is, that you open the urethra too far forwards; you divide the corpus spongiosum of the penis, which need not in reality be divided at all: and you are then certain of wounding the artery of the bulb of the urethra, which otherwise is, in most instances, avoided. Another inconvenience which attends this method of proceeding is, that the wound being too near to the scrotum, the cellular membrane of it is in danger of being infiltrated with blood; and another still is, that a greater mass of substance is left to be divided, when you continue the incision into the bladder, than there would have been if you had cut into the urethra farther back in the first instance.

I say, then, let the opening in the urethra be made deep in the perineum, behind the bulb, and as near as can be to the prostate. Place the thumb of your left hand on the skin over the staff; and in a man of ordinary size, about an inch and a quarter before the anus. Begin your incision immediately below this, on the left side of the raphe, and continue it backwards and towards the left side, into the space between the anus and the tuberosity of the left ischium. Here you may cut freely; you can injure nothing of consequence. Then feel for the staff in the wound; direct the point of your knife towards it, and carefully cut into the groove, where it lies in the membranous part of the urethra. All these incisions are, you will observe, made low down the perineum, that is, near to the rectum. I have already given you what I conceive to be sufficient reasons for avoiding incisions in the upper part of the perineum. I may add another, namely, that if the external part of the wound be in the lower part of the perineum, there is a depending orifice for the free discharge of the urine after the operation, which there would not be otherwise. There is also a great authority in favour of this mode of proceeding. Cheselden made his incisions in the way which I have mentioned, as is proved

by the anxiety which he evinced to avoid injuring the rectum. Had he done otherwise, it would never have entered into his contemplation that the rectum was in danger.

The next step of the operation is the continuance of the incision along the posterior part of the urethra, and the dilatation of the neck of the bladder. Some recommend this to be accomplished by means of the common scalpel, with which you have made the external incisions; the point being steadily introduced along the groove of the staff, with the edge turned outwards, so as to divide the left side of the prostate. This was Cheselden's method of operating. I draw this conclusion from Cheselden's own account of his operation, not from the absurd statement published by his contemporary, Dr. Douglas, who evidently understood nothing of the matter, and, indeed, describes an operation which it is next to impossible to perform. But after having incised the prostate and neck of the bladder, Cheselden introduced the instrument which I now show you, the blunt gorget, so as to dilate the wound still further, answering at the same time the purpose of a conductor for the forceps; and as far as I can learn, this method was followed generally by the English surgeons up to the time of Sir Cæsar Hawkins. This celebrated operator, who exercised his skill, and acquired his reputation, within the walls of our hospital, caused one side of the gorget to be ground to a sharp edge, and thus converted the blunt into a cutting gorget. The cutting gorget of Sir Cæsar Hawkins (and all those that have been since invented are but modifications of it) was intended to supersede the use of the knife in opening the neck of the bladder, at the same time that it answered the purpose of a blunt gorget in other respects. It would be presumptuous in me to say that the cutting gorget is not a good instrument, when it has been employed, not only by many of our most distinguished, but by some of our most successful lithotomists. Nevertheless, I cannot but think that there are some considerable objections to it. The incision is made as the gorget is thrust into the bladder. In consequence of the thick wedge-like form of the instrument, the prostate, and

especially a hard and enlarged prostate, offers to it considerable resistance. A certain quantity of force is necessary for its introduction; and if that force be not well applied, the beak may slip out of the groove of the staff into the space between the bladder and rectum,—an accident which is too surely followed by the death of the patient. Now I know that such an accident ought not to happen; but I also know that I have seen it happen to a very experienced and dexterous lithotomist. There is, of course, a still greater chance of its happening to an inexperienced lithotomist (and all are inexperienced in the first instance). These considerations lead me to recommend you not to begin with the cutting gorget: you may adopt it, if you please, afterwards. For my own part, although I have very frequently used the cutting gorget, I generally make the incision of the prostate with the knife which I now show you. You will observe that the blade is broad enough to divide a considerable portion of the prostate, as it enters the bladder, without its being necessary to increase the size of the incision by cutting laterally afterwards; and that, instead of a sharp point, it terminates in a beak, fitted to the groove of the staff. In ordinary cases, a knife of this kind, with a single cutting edge, is sufficient; but in cases of very large calculi, there are good reasons for dividing both sides of the prostate. There is no objection to this being done, that I can discover; and for such cases I have been for some time in the habit of using this double-edged knife, with a beak projecting from its centre.

Having made the opening into the membranous part of the urethra, you are to insert the beak of the beaked knife into the groove of the staff. You then take the handle of the staff into the left hand, depressing it at the same time. You depress your right hand also, so that the handle of the knife, which you hold in it, lies in the lower part of the external wound. You are now to push the knife along the groove of the staff into the bladder, with its cutting edge inclined outwards and a little downwards, towards the ramus of the ischium, if you use a single-edged knife; but holding it horizontally if you use one with a double-edge. Let

this be done slowly, cautiously, taking care that you do not lose the feeling of the beak sliding over the smooth surface of the staff for a single instant. Generally, as the knife enters the bladder, a few drops of urine escape, but never any large quantity. This being accomplished, you are to withdraw the knife along the groove of the staff in the same line in which you introduced it. Never cut with it laterally, except you find it afterwards absolutely necessary to do so, on account of the large size of the stone; for in cutting laterally, you will find it difficult to measure exactly the extent of your incision; and you may endanger your patient's life in consequence of your dividing the parts beyond the boundaries of the prostate.

The next step of the operation is to introduce your finger, directed by the staff, into the bladder, so that you may feel the parts which are divided, and determine whether the incision is properly made. If you operate on a child, or on a young and thin person, you may then at once introduce the forceps into the bladder. But if you operate on a full-grown person, and especially on one having a deep perineum, it will be prudent for you first to introduce this instrument, which we call a blunt gorget, previously to the use of the forceps. The blunt gorget is, as you perceive, an oblong plate of steel, turned up at the edges, so as to present a concave surface above, and a convex surface below. The handle is inclined downwards; and that extremity, which is opposite to the handle, gradually becomes narrower, and terminates in a beak similar to that of the lithotomy knife. The surgeon takes the blunt gorget in his right hand, and inserts the beak in the groove of the staff; then, holding the handle of the staff in his left hand, and depressing it at the same time, he carefully introduces the gorget into the bladder. Having done so, he withdraws the staff, and leaves the gorget in the wound.

The gorget is intended to answer the purpose of a director for the forceps. But it answers another purpose also; it is a dilator of the wound. The knife divides only a portion of the prostate. The gorget splits the remainder as far as its breadth allows it to do

so. Do not for an instant suppose that this is any rude or violent proceeding. It is far otherwise. The incision of the prostate having been begun by the knife, the extension of it by means of the blunt gorget is accomplished with the greatest ease. If you perform the operation on the dead body in the way which I have described, and dissect the parts afterwards, you will distinguish very readily the clean smooth surface made by the cut of the knife, from the fibrous or striated surface made by the splitting of the gorget. You will ask, Why not make such a division of the parts by cutting laterally with the knife? Why prefer the dilatation of the wound by the blunt gorget? My answer is, that the separation of the parts with the latter instrument causes no hæmorrhage; and that it ceases as soon as it reaches the margin of the prostate; that is, as soon as it reaches the condensed cellular membrane, which forms what may be called its capsule.

Before explaining the use of the lithotomy-forceps, I must show you its construction. One of the handles terminates in a ring, the other in a loop. The blades become broader towards the extremity; and their opposite surfaces are concave, and armed with small pointed projections, or teeth. When closed as far as they can be closed, the ends do not exactly come in contact. Thus they are well fitted to hold the stone, which they have seized, at the same time that, if the stone be not seized, it is impossible for them to pinch the mucous membrane of the bladder. This particular forceps is made according to the pattern of that which Cheselden employed on most occasions, as described by Douglas, and you will find it very generally useful. You must not, however, rely on this alone: you must have forceps which are longer and larger: others much smaller, especially for operations on children. You should be provided, also, with curved forceps, to be used where the stone lies in the hollow behind an enlarged prostate gland.

The surgeon, then, holding the handle of the blunt gorget with the left hand, introduces the forceps with his right, along the concave surface of the gorget, into the bladder. This is to be done cautiously, and without violence. But it is to be observed, never-

theless, that the forceps will always experience a certain degree of resistance, and that some force is necessary to make it enter the bladder. You know when it has entered by the resistance ceasing, and, in many cases, by a gush of urine taking place at the time. In a deep perineum the forceps will have to penetrate to a great depth before reaching the bladder. This is one of the sources of difficulty and doubt to a young surgeon, who is apt to think that the forceps must have actually entered the bladder, when it has, in reality, penetrated no farther than the prostate. The forceps having been introduced, the gorget is to be withdrawn.

The surgeon is not to open and close the forceps at random. He is to use it first as a sound, exploring the different parts of the bladder, until he has ascertained where the calculus lies. The discovery of it will be very much facilitated by the introduction of the finger along the groove of the staff, previously to the introduction of the blunt gorget; at least in most instances. In a case of enlarged prostate and deep perineum, where the finger will not reach the bladder, this mode of examination is, of course, of no avail. The calculus being touched by the forceps, the blades are to be opened upon it, and it is, in general, readily grasped. I have already mentioned a case in which the muscular coat of the bladder was ruptured, in consequence of the surgeon too forcibly and hastily opening the forceps; and this will be a lesson to you as to your conduct in this part of the operation. But I conceive that the danger of such an accident as this is not the same in all cases. In some instances, when you begin the operation, the bladder is distended with urine; then, when the instrument enters it, the urine rushes out, not impelled by muscular action, but by its own gravity and the pressure of the viscera. Under these circumstances, when you introduce your finger into the bladder, you find the muscular tunic relaxed, with the mucous membrane hanging in folds; and, in consequence, they are not likely to be ruptured. In other instances, the patient voids his urine immediately before the operation, or, perhaps, during the introduction of the staff. Here, the urine, having been made to flow by the patient's own

efforts, the muscular tunic is contracted: it offers a considerable resistance to the opening of the forceps, and is liable to be ruptured, if the blades are opened rudely and incautiously. It sometimes happens that a small calculus lies, as it were, concealed in some part of the bladder, perhaps beneath a fold of the mucous membrane, so that you cannot easily bring the forceps in contact with it. You will then frequently succeed in seizing it in the following manner:—Expand the forceps gently and carefully, until the blades are widely separated from each other, holding them at the same time in such a position as that the blades open horizontally. This dislodges the calculus, and causes it to fall to the lower surface of the bladder; and then, as you close the forceps, you find that you have seized it. In other cases, where there is a tumour at the neck of the bladder, caused by an enlargement of the prostate gland, the calculus is liable to be lodged behind the projection. You feel it; but the forceps slides over its surface, and does not grasp it. It is in such a case as this that the curved forceps is useful, being capable of dipping into the hollow behind the prostate. Under these circumstances, you may also find it useful to introduce the finger into the rectum, and raise the bladder by means of it, towards the pubes. It is evident, however, that this expedient can be of no use, except where the bladder is within reach of the finger, which it rarely is in a case of enlarged prostate.

The next thing to be done is the extraction of the calculus with the forceps; and, simple as it may appear to be, there are several things to be attended to in this part of the operation.

The forceps is to be withdrawn from the bladder in the direction of the external wound. For the most part, it is better that the convexity of one blade of the forceps should be turned upwards, and that of the other blade downwards. Attention to this point is especially of consequence, in cases where there is an enlarged prostate gland, forming a tumour projecting into the bladder. The smooth convex surface of the blade of the forceps is not interfered with by the projection; whereas, if the forceps be turned in the

other direction, the calculus, coming in contact with the tumour, becomes as it were entangled by it, and the extraction of it is rendered difficult. The calculus must be grasped with a certain degree of force, otherwise it may escape from the forceps. But, on the other hand, it is important that you should not, in ordinary cases, apply so much force as to crush it, for this will make the operation not only more difficult, and tedious, and painful, but also more dangerous. You should always endeavour to determine, before you proceed to the operation, what is the probable nature of the concretion, in order that you may judge how far it is, or is not, likely to be easily broken. The lithic-acid calculus is of a very hard texture, and is broken with difficulty. The oxalate-of-lime calculus is also hard, but it is more brittle than the lithic-acid calculus. If the urine be alkaline, without containing the adhesive mucus secreted by the bladder, you know that the external layer is composed of the triple phosphate, and a calculus of this kind is much more easily broken than either of those which have been before mentioned. But the most brittle of all, and that which requires the greatest degree of caution in its extraction, is the fusible calculus, formed partly by the triple phosphate of the urine, and partly by the phosphate of lime generated by the adhesive mucus secreted by the membrane of the bladder; and the greater the quantity of the adhesive mucus, and the larger the proportion of the phosphate of lime, the more liable is the calculus to be crushed beneath the pressure of the forceps.

If, having seized the stone, you find that it cannot be readily drawn through the neck of the bladder, you are to bear in mind that this may be because you have hold of its long diameter. Let it then drop out of the forceps, and endeavour to seize it in a more convenient manner. In some cases you will find it expedient to dilate the wound of the prostate by a second incision. This, however, is never proper, except where you have divided only one side of the prostate in the first instance. You may then introduce a straight probe-pointed bistoury, and make an incision in the opposite or undivided side of the prostate. But this is to be done with

the greatest caution. A careless incision may occasion a frightful hæmorrhage, or it may extend beyond the boundaries of the prostate into the cellular texture external to it; and I have already explained to you how much this may endanger the life of the patient.

It is scarcely possible for me to say too much as to the caution necessary in the extraction of a large calculus. You must command not only all your skill, but all your patience; indeed, patience is here the greatest indication of skill. You are to draw it out gradually, endeavouring to dilate the parts through which it is to pass, instead of tearing them; and it is astonishing to what an extent this gradual dilatation may be accomplished in the hands of a prudent surgeon. I have told you how important it is that you should avoid crushing the calculus. But even this rule has its exceptions. It may be so large that no degree of gentleness and caution will enable you to extract it entire without extensive laceration of the neck of the bladder, extending into the surrounding cellular membrane; and, under these circumstances, it is the smallest of the two evils that it should be broken into pieces. The fragments are to be extracted one after another, larger or smaller forceps being used, according to circumstances. Some of the smaller fragments may be removed by means of this instrument, a kind of steel spoon, to which we gave the name of a scoop; and the very smallest of all may be washed out of the bladder, by introducing the pipe of a syringe into it, and injecting into it a sufficient quantity of tepid water. You are to ascertain, at last, whether the whole of the fragments are extracted, by exploring the cavity of the bladder carefully, by means of this straight sound introduced by the wound, and, in most cases, also by examining it with the finger.

When a fusible calculus, containing a large proportion of the phosphate of lime, is broken, it often happens that some of the fragments are of so small a size that they remain like particles of coarse sand in the bladder, even in spite of all the precautions which you can take at the time of the operation, and further

attentions are required. Let the patient recover of the first effects of the operation: then once or twice daily introduce a catheter by the urethra into the bladder, and inject half a pint of tepid water, or of a weak infusion of linseed, through it, by means of an elastic gum bottle. The liquid flowing in by the catheter will flow out by the wound, carrying the particles of sand with it; and thus, at last, the bladder will be emptied of them. In a case of enlarged prostate, indeed, this plan may not answer; as frequently the patient is not more able after the operation to empty the bladder by the wound, than he was before to empty it by the natural passage. For these cases you must be provided with a large catheter, having an aperture three or four times the size of that commonly made, close to the point, on the upper or concave side. The liquid being injected by the catheter, will be discharged by it also, carrying every time some of the small fragments of calculi with it, until none are left in the bladder.

It very rarely happens that you meet with an encysted calculus where you perform the operation of lithotomy. In fact, in the great majority of cases of encysted calculi, the bladder is diseased; so that they are quite unfit for an operation. However, such an event occurs occasionally. A boy, about sixteen years of age, was admitted into the hospital in the year 1816. He had suffered a long time from stone in the bladder. There were these remarkable circumstances in his case; namely, that the calculus could sometimes be felt distinctly with the sound, appearing to be of a larger size, while at other times it could not be felt at all; and that, sometimes, when the bladder was empty of urine, it could be perceived distinctly with the finger from the rectum, while at other times, when there was urine in the bladder, it could not be detected at all by this mode of examination. In performing the operation, when I had introduced my finger into the bladder, I could, at first, discover no calculus. At last I felt it on the anterior part of the bladder, behind the pubes. It was not lying loose in the cavity of the bladder, but evidently contained in a cyst, communicating with the bladder by a round opening. By means of a probe-pointed

bistoury, I carefully dilated the orifice of the cyst, and then, introducing my finger, separated the membrane of it from the calculus, until I was enabled to take hold of the stone with the forceps. The calculus is preserved among those in our museum. It was not only encysted, but adhering also, for it was brought away with a portion of the membranous lining of the cyst closely attached to it. The boy recovered.

After the operation your patient is to return to his bed, where he is to be laid on his back, with his shoulders and loins as much elevated as they can be without inconvenience, so as to make the wound in the perineum as depending as possible. The thighs are to be somewhat elevated by a bolster placed under the hams, and the knees are to be a little asunder. The urine flows, not through the urethra, but through the wound; and the first and two or three succeeding gushes of it, usually give the patient a good deal of smarting pain. In many cases, where there has been a deep perineum, and especially where the calculus has proved to be of a large size, I have introduced an elastic gum canula through the wound into the bladder, and allowed it to remain for the first two or three days; that is, until there was time for the surrounding parts to become consolidated by inflammation. Such a canula makes an excellent conductor for the urine. It keeps the bladder always empty, and prevents the pain which otherwise is experienced on the first passage of the urine. It prevents also an obstruction to the flow of the urine which sometimes occurs after the operation, in consequence of the wound having become plugged by a coagulum of blood. In cases in which the calculus has been of so large a size as to make it probable that, in the extraction of it, the soft parts have been lacerated beyond the boundaries of the prostate, the canula will answer another good purpose, by lessening the danger of the urine becoming effused into the cellular membrane.

In ordinary cases, the after treatment is very simple. The wound requires little more than attention to cleanliness; for of what service can applications be to a wound, over which the urine constantly flows? It gradually contracts and granulates; and as

it does so, the urine begins to flow by the urethra. As the wound becomes more contracted, more urine flows by the natural passage; and usually, in less than a month from the time of the operation, the function of the urethra is completely restored, and the wound is healed.

In a few cases there may be a reason for applying leeches to the lower part of the abdomen, and in still fewer it may be right to take blood from the arm. Fomentations applied to the abdomen are sometimes proper also; and to this we may add the precautions necessary after most other operations with respect to the functions of the intestines and the diet.

There are cases, however, in which still further attentions are required. Where the bladder is in a state of chronic inflammation before the operation, secreting adhesive mucus, the inflammation is almost invariably aggravated by the necessary introduction of instruments at the time of the operation, and there is an increased secretion of the mucus afterwards. Again, in some cases, where these symptoms did not exist previously, they are induced by the operation. Now, under these circumstances, the mucus being liable to deposit the phosphate of lime, and the whole of the urine being rendered alkaline, there is a great liability to a calculous formation, and it will often require much care to prevent this calamity coming a second time upon the patient. Opium, mineral or vegetable acids, and especially the decoction of the pareira brava, may be here resorted to with advantage. But I need not occupy your time by a detail of the treatment which is proper under these circumstances; it is sufficient for me to refer you to what I said on this subject in the first of my Lectures on Calculous Disorders. In some of these cases, the whole of the wound becomes encrusted with a white calculous deposit. Stimulating applications to the surface of it are then likely to be useful; such as a lotion of a decoction of bark and tincture of myrrh, solution of the nitrate of silver, or of nitric acid. As by other means the urine is brought into a more healthy condition, these lotions promote the separation of the concretion from the surface of the wound, which then is brought into a state to granulate and heal.

LECTURE XIV.

ON THE CAUSES OF DEATH AFTER LITHOTOMY.

It is much more agrêeable to contemplate the cases in which our art is successful, than those in which it fails: but the study of the latter is not less instructive than that of the former; and I should be guilty of a serious omission if I were to dismiss the subject of lithotomy without endeavouring to explain the circumstances which render the operation hazardous; under which it is likely that it will shorten the patient's life, instead of leading to his cure.

I have already pointed out what I conceive to be the bad consequences of a too free division of the prostate gland. All that I have been able to observe for many years past has confirmed me in the opinion, that *an incision of the prostate, extending into the loose cellular texture surrounding the neck of the bladder, is replete with danger to the patient.* Such a division of parts is never necessary where the calculus is of moderate dimensions; but it cannot be avoided where it is of a very large size; and hence the extraction of calculi of this description can never be accomplished without a great probability of the patient not surviving the operation.

The symptoms which arise in these cases are not well marked in the first instance. There is some heat of skin, and generally an absence of perspiration; there is usually an abundant flow of urine through the wound; the pulse, as to frequency, is somewhat above the natural standard; and the patient, although free from suffering, has no disposition to sleep. This state of things continues for twenty-four, or even for forty-eight, hours after the operation; then the more characteristic and alarming symptoms show them-

selves. The pulse becomes more frequent, rising to 90, 100, and at last to 140 in a minute; the heat of skin becomes still greater; the tongue dry; the countenance anxious. Afterwards, as you count the pulse, you find every now and then a beat weaker than the rest; and then there are complete intermissions. At first the intermissions are not more than one or two in a minute; by degrees they become more frequent, until they occur every third or fourth beat. There is an occasional hiccough; the patient complains of some degree of tenderness in the lower part of the abdomen, especially in the left groin; the belly becomes tympanitic, that is, the stomach and intestines are filled with air; the distention of the belly increases; the hiccoughs are more frequent; the pulse, continuing to intermit, becomes weak and fluttering. In some instances, the patient retains his understanding even to the last; while in others he falls into a state of low delirium previous to death. Occasionally, in the progress of such a case, the patient has a severe rigor, and sometimes he complains of a pain in the loins. Where these symptoms begin at an early period, he may die within forty-eight hours from the time of the operation; but in other cases, death may not take place for four or five days, or even for a week. On dissection you find the cellular membrane round the neck of the bladder, and between the prostate and the rectum, bearing marks of inflammation, infiltrated with lymph and serum; and, to a greater or less extent, converted into a slough. If death has taken place at an early period, the intestines are found distended with air, and there is a very slight effusion of serum in that part of the peritonæum which descends into the pelvis. But if the patient has laboured under these symptoms for many days before he dies, the peritonæum, where it is reflected from the bladder to the rectum, is seen of a darker colour than natural, and encrusted with lymph; and, at a still later period, there is the appearance of inflammation, to a greater or less extent, throughout the peritonæum generally. But the peritonæal inflammation is evidently *not the primary disease*; it is the inflammation and sloughing of the cellular membrane of the pelvis which has in-

duced inflammation of the adjoining portion of that membrane. Something also is to be attributed to the tympanitic distention of the intestines, which, if continued for a considerable time, is always liable to be attended with tenderness of the abdomen, and some degree of peritonæal inflammation.

It is important that you should not fall into the error of regarding such cases as I have just described as cases of simple peritonæal inflammation; for the remedies which would be useful in the latter case are injurious here. The abstraction of blood, or even the operation of an active purgative, will cause the patient to sink more rapidly, tending only to hasten his death. The proper system to be pursued is the opposite to that of depletion. The patient should take such nutriment as his stomach is capable of digesting. The bowels may be kept open by injections, or by the exhibition of some very gentle purgative; and ammonia, wine, and brandy are to be administered, accordingly as the state of the general system indicates that stimulants are necessary.

Under this kind of treatment I have certainly known two children to recover, who were affected in the manner which I have described. In one of the cases to which I allude, an abscess formed in the neighbourhood of the neck of the bladder, which burst into the wound, and then the symptoms subsided. In the other a slough separated into the rectum, and a fistulous communication remained afterwards between that bowel and the neck of the bladder; but it was of a small size, and productive of no serious inconvenience. In adults the chance of recovery is, at any rate, much smaller than in children. Can anything be done for their assistance in the way of local treatment? Let us consider how it is that the dangerous symptoms arise. There is suppuration and sloughing of the cellular membrane round the neck of the bladder, and the constitution is disturbed, as it is in a case of carbuncle; or, what is still more analogous, as it is in those cases in which there is sloughing of the cellular membrane of the scrotum, in consequence of the effusion of urine arising from the rupture of the urethra behind a stricture. And, in these cases

what is the practice recommended? Do we not divide the soft parts freely over the sloughing cellular membrane; and is not this operation productive of the most signal benefit? Is it possible to resort to any practice corresponding to this, in the cases now under our consideration? There is only one way in which this can be accomplished, namely, by laying the sloughing abscess open into the rectum. I made this experiment in one instance, and I will tell you the result. In September, 1825, I operated on a patient, a man between fifty and sixty years of age, labouring under calculus in the bladder, in St. George's Hospital. It was extracted without the smallest difficulty. But I performed the operation with what is called Mr. Blizard's lithotomy knife. This is a long, narrow, straight, probe-pointed bistoury, and you must cut with it laterally, in order that you may divide the prostate, so that it is difficult to determine the exact extent of the incision. Immediately after the operation, I had some misgivings, and was led to fear that I had made the incision to such an extent as to penetrate beyond the boundaries of the prostate. At first, indeed, the patient seemed to be going on as well as possible; but, in about forty-eight hours from the time of the operation, some unfavourable symptoms began to show themselves. On the third day the countenance had become anxious, the skin was hot, and the pulse occasionally intermitted. On the following day (the fourth) the pulse intermitted once in fifteen beats; the skin was hot and dry, and the abdomen began to be tense and swollen. I could not doubt that those symptoms existed which I had known to be the precursors of death in some other cases. Under these circumstances, with the concurrence of my colleagues, I performed the operation which I am about to describe. I introduced the fore-finger of the left hand into the rectum. I then passed a probe-pointed curved bistoury into the wound, and quite to its farthest extremity on the left side of the neck of the bladder. The probe point having been felt through the tunics of the rectum, I pushed it carefully through them, and, drawing it downwards, divided the lower part of the rectum, sphincter and all. Thus the wound and

the rectum were laid into each other. Little or no hæmorrhage followed. The relief was immediate. In five minutes after the operation the intermissions of the pulse had diminished from one in fifteen to one in fifty beats. In an hour it did not intermit at all. During the two following days the patient appeared quite well; the pulse was regular, between 70 and 80 in a minute. On the next day there was a slight recurrence of the intermissions of the pulse, but it subsided on the exhibition of some brandy and ammonia. After this there was a progressive amendment; the pulse, however, continuing to beat between 80 and 90 in a minute for the two or three following weeks. After about a month, the wound in the rectum began to contract, and the urine to flow by the natural passage; and in another fortnight the patient went into the country, nearly the whole of the urine at this time flowing by the urethra.

I have already informed you that my experience does not justify me in stating, that, after the operation of lithotomy, there is no danger of death from hæmorrhage; and I have mentioned that I had myself the misfortune of losing one patient from this cause. This case, which occurred many years ago, was that of an old man, with an enlarged prostate and an unusually deep perineum. The blood seemed to proceed from the neighbourhood of the neck of the bladder, and, what was remarkable, it was venous. I was foiled in all my attempts to restrain the hæmorrhage, and the patient survived the operation only a few hours.

I have known some other cases of death from hæmorrhage, occurring in the practice of other surgeons. It must be acknowledged, however, that such cases are but a very few out of a great number; and that the chance of a patient's bleeding to death, where the incisions are made low down, and are not more extensive than is really necessary, and where proper attention is paid, and proper precautions are used after the operation, is so small, that it need not enter into your calculations. I speak of attention and precautions after the operation; for without these, I suspect a dangerous hæmorrhage would occur more frequently than it does.

I performed the operation on an old gentleman, and extracted a large calculus. But a still larger one remained in the bladder, which could not be extracted through the incision which I had made, without the application of what I conceived to be a dangerous degree of force. I therefore made another incision in the right side of the prostate, with a straight probe-pointed bistoury, and the calculus was then easily extracted. A frightful hæmorrhage followed the last incision; so that I have no doubt that the patient would have died from loss of blood, if an assistant had not pressed the internal pudic artery against the bone with his finger for several hours. Some years before this, soon after I had been elected assistant surgeon to the hospital, Sir Everard, then Mr. Home, operated on an elderly man for calculus in the bladder. There was a considerable bleeding at the time of the operation, but it was not much regarded, and the patient was taken to his bed. About half an hour afterwards, the nurse came to me in great alarm, saying that the *stone-patient* was bleeding to death. When I reached his bedside, I found him pale and yawning, the bed drenched with blood, and a complete puddle of blood on the floor under the bed also. I drew him to the end of the bed; and, having placed him in the position in which he had been placed for the operation, found the blood still flowing from the wound. On pressing the internal pudic artery of the left side against the bone, by means of the finger, the hæmorrhage was immediately suspended. Fortunately, the patient was a thin person, and, without any great difficulty, with the assistance of a small flexible silver needle, I was enabled to pass a ligature round the trunk of the pudic artery. This fully answered the intended purpose. The patient was saved; but, if assistance had been delayed even a few minutes longer, it must have been unavailing.

I have sometimes heard it observed by bystanders, when a patient has lost a good deal of blood at the time of the operation, 'that he has lost no more than it will do him good to lose.' I have, however, great doubts whether, even in the case of the strongest man, the losing blood adds to his chance of recovery;

and it is evident that, in the case of a person of originally weak constitution, or of one whose bodily powers are exhausted by his previous sufferings, or who labours under disease of the bladder or kidneys, the loss of a considerable quantity of blood in the operation is likely to make all the difference between its success and failure.

I may take this opportunity of observing, that secondary hæmorrhage sometimes occurs after lithotomy: I suppose, in consequence of the separation of the slough. A little boy, on whom I had operated, lost, what was, for him, a large quantity of blood; and (if I recollect rightly, for I have no notes of the case) some time in the second week after the operation. He was excessively lowered by the hæmorrhage, but ultimately recovered. Mr. Earle related to me a case of hæmorrhage seven or eight days after lithotomy, which occurred to him in St. Bartholomew's Hospital. The bleeding was sufficient to be alarming; but he succeeded in stopping it by introducing through the wound into the bladder a tent, composed of a quantity of lint, wrapped round an elastic gum catheter.

Patients may, and continually do, recover, in whom circumstances have occurred causing the operation to be protracted for a considerable time. Nevertheless, other things being the same, it must be presumed that, as the operation occupies a longer time, so it is more dangerous. When I was a student at the hospital, a large fat man, with a very large calculus, submitted to the operation. He was in good health otherwise, but the stone broke into a number of fragments. There was a deep perineum; and these circumstances combined made the operation very difficult, although performed by Sir Everard Home, who was a very skilful lithotomist. The patient was more than an hour on the table. He died very soon after being taken back to bed, manifestly from exhaustion.

The causes of failure which I have already enumerated are connected with circumstances which occur during the operation, and which may be supposed to be, to a certain extent at least, under the control of the surgeon. But there are other cases, in

which death takes place as a consequence of the operation, although nothing has happened in the performance of it which the most anxious surgeon could wish to have been otherwise. Some individuals are good subjects for the operation, and recover, perhaps without a bad symptom, although the operation may have been very indifferently performed. Others may be truly said to be bad subjects, and die, even though the operation be performed in the most perfect manner. What is it that constitutes this essential difference between these two classes of cases? It is, according to my experience, the presence or absence of organic disease. A patient with organic disease of other organs has a smaller chance of recovery than he would have had if such disease did not exist; but it is organic disease of the urinary organs, the kidneys, or bladder, or parts connected with them, that is to be especially apprehended, as increasing, tenfold, the hazard of the operation. Of persons in whom the calculus is not of a large size, on whom the operation is performed, I will not say very well, but not very unskilfully, and who are free from all organic disease, there are very few who do not recover; while, of those, in whom organic disease exists, there are few who do not die. It becomes, then, the duty of the surgeon to consider what are the organic diseases most likely to occur in combination with stone in the bladder, and how they are to be recognised in the living person, in order that he may be enabled to judge, before he proposes an operation, or before he accedes to the patient's wishes that he should undertake it, how far it is, or is not, probable that it may prove successful.

The common enlargement of the prostate gland, such as occurs in old men, and existing in a moderate degree, does not, as far as my observation extends, add to the danger of the operation. In fact, it succeeds, on the whole, better in old men between seventy and eighty years of age, than in those who are ten or twenty years younger, although the former are likely to have the prostate of a larger size than the latter. An excessive enlargement of the prostate, however, is to be regarded as an unfavourable circumstance, inasmuch as, by adding to the distance between the bladder and

skin of the perineum, and placing the bladder beyond the reach of the finger, it increases the difficulties of the operation to an extent which cannot be well estimated by one who has not had personal experience of what those difficulties are. I may take this opportunity of mentioning, that I have performed the operation on two individuals, who for some time previous, in consequence of the enlargement of the prostate, had been unable to void a drop of urine without the aid of the catheter. The first of them remained in this respect, after the operation, exactly as he was before, and required the use of the catheter, even while the wound in the perineum was still open. The other not only regained the power of making water, but, two years after the operation, was still able completely to empty his bladder by his own efforts.

It sometimes happens that the prostate gland, where it projects into the bladder, is ulcerated. I have formerly explained to you what are the symptoms produced by this combination of ulcerated prostate and calculus in the bladder. It remains for me to tell you the result of the operation of lithotomy, performed under these circumstances. When I was a very young member of our profession, I was present at two such operations. In the first of these cases the operation was recommended by two of the most eminent surgeons who were then in practice. It was performed, to all appearance, dexterously, occupying scarcely three minutes. The patient died within ten minutes after he had been replaced in bed. In the second case the bladder contained eighteen or twenty calculi (I believe more), which, of course, made the operation more tedious. As soon as it was over, the patient fell into a state of stupor, from which he never recovered. He died in about twelve hours.

Chronic inflammation of the mucous membrane of the bladder is not very uncommon in cases of calculus in the bladder; and although by no means a favourable circumstance, is not to be regarded as so unfavourable as to justify you in declining to perform the operation on this account; indeed, if you were to do so, all your patients with fusible calculus would be left to die, for it is

on this chronic inflammation that the deposition of the mixed phosphates, which constitute the fusible calculus, usually depends. But chronic inflammation of the mucous membrane is sometimes aggravated, so much so, indeed, as to assume the characters of acute inflammation. The inclination to void the urine is then incessant, night and day, preventing sleep, and attended with horrible suffering. The urine deposits a large quantity of offensive, ropy, adhesive mucus, of a red colour, in consequence of blood being blended with it. Such cases as these are unfavourable for the operation. It may hasten the patient's death; or more frequently the patient will die in spite of it, and the operation will have the credit of having occasioned his dissolution. I have twice performed the operation under the circumstances which I just mentioned. In neither case did I recommend it, but the contrary. The patients, however, required it of me, being driven to it by excessive suffering; and I performed it in compliance with their wishes, as a matter of duty. I will tell you the result. The first patient experienced great and immediate relief. The wound granulated, and was completely healed in less than three weeks; but, nevertheless, it was evident that there was something wrong. The patient was languid and listless, incapable of exertion, and not even desiring to make it. At the end of a fortnight, or rather more, he began to complain of pains, like those of rheumatism, but more severe, in the shoulder, arm, and other parts of the body. He had rigors, gradually became weaker and weaker, and died about a month after the operation. On examining the body, the mucous membrane of the bladder was found still bearing the marks of much inflammation. The inflammation had extended to the cellular membrane external to the bladder, which was, in some parts, infiltrated with lymph and serum; and a small quantity of pus had been effused in the neighbourhood of one ureter. One of the kidneys was almost completely wasted; but this was manifestly the result of disease at some former period, and, in all probability, had no immediate connection with the patient's death. In the second case there was also great immediate relief: so that

for some days there were no bad symptoms of any description, and I told the patient's friends that all danger from the operation was at an end. But at the end of about a week from the time of the calculus having been extracted, he began to sink. It was difficult to say what he ailed, but it was evident that his physical powers were on the decline; and in the course of four or five days more he died. On examining the body, the mucous membrane of the bladder was found to be of a dark colour, in consequence of its vessels being very much loaded with blood. The same appearance was traced along the membrane of the ureters to the pelves and infundibula of the kidneys, and these last-mentioned parts were distended with what appeared to be an admixture of pus and adhesive mucus.

From what I have seen in some other cases, I am led to believe that these patients would have died nearly as soon, perhaps quite as soon, if the operation had not been performed. They died, as I have already said, in spite of the operation, and not in consequence of it. But these are distinctions which the public, and even some members of our own profession, do not comprehend. It is desirable, on all accounts, to avoid, if possible, performing an operation under these peculiar circumstances. Such cases only tend to bring it into disrepute, and prevent some other persons submitting to it, in whom there might be scarcely a doubt as to its success.

In the last-mentioned case there was disease in the kidneys, the consequence of inflammation extending upwards along the ureters, from the mucous membrane of the bladder. But disease originating in the kidney, where the bladder itself is in a healthy state, equally adds to the danger of the operation. The patient is unable to bear the shock which the operation gives to his nervous system, and the loss of blood which unavoidably attends it, and dies either immediately after the operation, or before the wound is healed. It is true that he labours under a mortal disease; and that he would have died sooner or later if the operation had not

been performed; but the operation hastens his death, and is therefore to be avoided.

A boy, sixteen years of age, a midshipman in the navy, had for many years laboured under severe pains in the loins, and latterly had suffered from the usual symptoms of calculus in the bladder. The poor fellow, however, went on doing his duty on board ship, until he could do it no longer. He was then placed under my care. His sufferings from the calculus were excessive; and, in addition to these, he had severe pains in the loins, and occasional rigors. The urine was turbid, and when exposed to heat, or on the addition of nitric acid, exhibited a large deposit of albumen; and Dr. Prout, who was consulted with me, detected some other circumstances connected with its chemical composition, which he had never before noticed, except in combination with organic disease of the kidney. Besides all this, the patient was depressed and languid, and losing flesh. Under these circumstances, Dr. Prout and myself strongly advised that he should not undergo the operation. Some time afterwards, however, his sufferings from the disease became so severe, that he declared he would rather die than submit to them any longer; and at the earnest request of himself and his friends, I removed the stone from the bladder. It was of a moderate size, and composed of the oxalate of lime. Everything in the operation and immediately after it was as favourable as possible. For the first week, the patient seemed to go on well: he was free from pain, and happy, and his health improved. The only remarkable circumstance was an enormous secretion of urine, amounting to diabetes. At the end of a few days this ceased, but it was followed by a profuse diarrhœa. There was a succession of watery evacuations from the bowels, which nothing could check. He became weaker and weaker, had a shivering, and died before the usual reaction took place, about a fortnight after the operation. On examining the body, an enormous abscess was found in one kidney, and connected with it, five or six calculi of the oxalate of lime, of various sizes and of irregular shapes.

The following remarkable case occurred in this hospital in the year 1808. Sir Everard (then Mr.) Home performed the operation for stone in the bladder on a boy seventeen years of age. The patient was in a state of depression previous to the operation; but with such knowledge as existed at that time on these subjects, it was not supposed that there were any sufficient reasons why he should not undergo it. In the course of the following night, however, he died. On dissection, the bladder was found inflamed, and the mucous membrane ulcerated. The ureters, pelves, and infundibula of the kidneys were dilated. The kidneys themselves were of a pale colour, and in the upper part of each of them was a large abscess. The abscess connected with the right kidney had burst into the abdomen (probably at the time of the operation), and not less than half a pint of pus had become effused into it immediately below the liver.

Before determining on lithotomy, you have no more important duty to perform than that of inquiring into the state of the kidneys. I have already explained to you what symptoms mark the existence of disease in the kidneys, connected with calculi. One thing to be especially attended to, with a view to a correct diagnosis, is the state of the urine. The urine may be alkaline, and thus in an unnatural state, and yet the kidneys may be free from organic disease, and the patient a proper subject for the operation. It is purulent and turbid urine, loaded with albumen, by which your apprehensions as to the result of an operation will be chiefly excited. Albuminous urine, however, where all other circumstances are quite favourable, affords no good reason for your declining the operation. I had a patient with stone in the bladder, a gentleman sixty years of age, whose urine was constantly turbid when first voided, depositing albuminous or fibrinous matter afterwards. At first, I hesitated to recommend the operation; but finding that he had no other bad symptoms, my opinion altered. I performed the operation; the patient recovered without the smallest untoward circumstance occurring, and lived for several years, dying at last of another complaint.

Success in lithotomy must undoubtedly depend in a great degree on the manual skill of the surgeon, and on the mode in which the operation is performed; but it depends still more on the condition of the patient with respect to his general health, especially on the existence or non-existence of organic disease. Not a little may be attributed to accident, which may at one time throw in your way a succession of cases which are favourable, and at another time a succession of cases which are unfavourable to the operation; and hence it has often happened, that a surgeon, who has been fortunate in the results of his practice as a lithotomist at one period, has been unfortunate at another. An experienced surgeon has generally an advantage over others, in consequence of his greater skill in diagnosis, by which he is enabled to determine whether the constitution be, or be not, oppressed by any organic disease, especially of the urinary organs, and parts in immediate connection with them. What I have said in former lectures will, I trust, be found of use to you on these occasions. But let me give you one caution more: never hastily proceed to an operation where a calculus has existed in the bladder for a great number of years. It is in such cases especially that you are to expect it to be of great magnitude, and that you are also to apprehend the existence of disease in the bladder or kidneys, or abscess in the cellular membrane of the pelvis. Be assured, that the operation seldom fails where it is resorted to at an early period; but that there is always danger in delay. Many an individual, influenced by his own fears, or in compliance with the absurd advice of his friends, has missed the period at which an operation would have been almost free from danger; has dragged on an anxious and uncomfortable existence, month after month, and even year after year; trying, at one time, medicines prescribed by regular physicians, and, at another time, medicines prescribed by quacks—all to no purpose; and at last has been driven by his sufferings to make up his mind to undergo the operation, when his condition has become so altered, that a prudent surgeon would either altogether decline to undertake it, or would perform it with

great unwillingness, and solely as an act of duty, or, if you please, of humanity, towards a suffering fellow-creature.

ON SOME OTHER METHODS OF LITHOTOMY.

Whatever advances may have been made in the other parts of surgery, it may be confidently asserted, that there has been no real improvement in the lateral operation of lithotomy since it was practised by Cheselden, more than a century ago. The method which I have described to you is, indeed, that of Cheselden, from whom it has been adopted generally, not only by the operators of this country, but by those of the Continent of Europe.

There have not been wanting, however, ingenious persons, who have endeavoured to extract calculi from the bladder in other ways, in the expectation of discovering an operation simpler, or safer, than that of Cheselden. Of late years, an attempt has been made in Paris to revive the high operation, in which the incision of the bladder is made at its fundus, where it lies behind the pubes, and immediately below the part at which the peritonæum is reflected over it. The high operation was, indeed, recommended by Cheselden himself, in the early part of his career; but he soon abandoned it for the lateral operation, from which last method he never deviated afterwards. The late advocates for the high operation, however, suppose that they have made in it an essential improvement, inasmuch as they adopt means for keeping the bladder empty of urine afterwards, so as to allow the wound in its fundus to heal, without the danger of an effusion taking place into the surrounding cellular membrane. For this purpose some make an incision into the urethra from the perineum, from which they introduce an elastic gum canula into the bladder; while others employ the simpler expedient of a gum catheter, introduced by the urethra in the usual manner. I have been present on three or four occasions, when the high operation was performed; but nothing that I have witnessed would lead me to recommend it to you; nor, indeed, does it appear to me that you would be justified in the performance of it, except in the case of a thin person, with

a stone of so large a size, that the extraction of it by the usual method would be either impracticable, or attended with the greatest risk to the patient's life. But even for cases such as these, it may be a question, whether there is not a better method of proceeding, in the recto-vesical operation; in which the incision of the perineum is made to extend through the tunics of the rectum and the sphincter ani muscle. Here the parts which afford the chief resistance to the extraction of a large stone are divided; and, although the incision of the neck of the bladder extends beyond the boundaries of the prostate, the ill consequences arising from the escape of urine into the cellular membrane are likely to be in great measure obviated, in consequence of the free opening which has been made into the rectum. If you refer to a case which I have already related, in which, some days after the removal of a calculus by the usual method, I was induced to lay the wound of the perineum, as far as the neck of the bladder, completely into the rectum, you will find in it much in favour of the recto-vesical operation in those cases, in which the great bulk of the stone makes an extensive incision of the prostate and bladder necessary. Further than this, I have little to offer, from my own experience, on this subject. In the only instance in which I performed the recto-vesical operation, the patient, who had suffered from a stone in the bladder for more than twenty years, died in about three weeks, with abscesses in the kidneys, and a large abscess on one side of the pelvis, having no communication with the wound, and which I believe to have existed long before he came under my care. The stone in this case had been supposed to be of an unusual magnitude. It proved to be much smaller than was expected; but I felt convinced at the time, that if it had been many times larger than it was, it would, nevertheless, have been extracted with the greatest facility.

CALCULI OF THE PROSTATE GLAND.

Calculi occasionally form in the ducts of the prostate gland. In the museum of this hospital there is a preparation of an enlarged prostate, in every part of which are found minute calculi, none of

them bigger than a pin's head, and too numerous to be counted. In general, however, they are fewer in number, and larger in size; I have seen them as large as a pea, or even as a horse-bean. They are composed of the phosphate of lime, are of a light brown colour, and not unfrequently are smooth and somewhat glossy on the surface. I believe that they frequently exist for a considerable time, without the patient being aware that he labours under any kind of disease. In other cases they cause a sense of irritation, referred to the perineum and neck of the bladder, and sometimes a difficulty of making water; so that patients have applied to me, supposing themselves to labour under a stricture of the urethra, whose real complaint was the formation of prostatic calculi.

We know of no medicine that is capable of preventing the formation of this kind of calculus; and in ordinary cases there seems to be nothing for us to do, beyond the occasional introduction of a full-sized bougie, to keep the urethra dilated, and thus favour the escape of the calculi as fast as they become disentangled from the ducts of the prostate, in which they have been generated.

There are some cases in which a number of these calculi are collected in a cyst in the prostate gland plainly perceptible by means of a metallic sound introduced into the urethra, and just before it enters the bladder; to be felt also from the rectum, sliding on each other under the pressure of the finger. In a case of this kind you may introduce a staff into the urethra: and, with this for your guide, make an incision in the perineum extending to the prostate, but not into the bladder, and thus extract the calculi. Several years ago, in a case of this kind, I succeeded in removing a large number of prostatic calculi with the assistance of Weiss's urethra forceps. There is always danger of some of these calculi finding their way into the bladder, and thus laying the foundation of calculi of that organ. This happened in the case to which I have just referred; so that, after I had completely emptied the cyst of the prostate, I had to remove a considerable number of calculi, of a still larger size, but of the same chemical composition, from the cavity of the bladder.

TREATMENT OF CALCULUS OF THE FEMALE BLADDER.

In women, calculi of a small size are expelled, as they are in the male sex, without ulceration or other injury to the urethra, and without the patient suffering any inconvenience afterwards.

Calculi of a very considerable size occasionally escape from the female bladder; but the natural cure in these cases is effected by a less simple process. A woman was admitted into our hospital, under the care of the physicians. On inquiring into her case, the apothecary of the hospital found a large calculus lying in the vagina, and he extracted it with his fingers. The urethra and vagina had ulcerated, and the calculus had passed through the ulcerated opening. The patient was thus relieved of the disease under which she had for a long time laboured; but it left another and very distressing disease behind it, namely, an incontinence of urine. Many cases similar to this have been recorded by writers; and you will find a paper on the subject, which is well worthy of your attention, by Dr. Yelloly, in one of the volumes of the 'Medico-Chirurgical Transactions.' There is reason to believe that incontinence of urine always follows the natural cure, where the calculus has made its way out of the bladder by ulceration.

The peculiar structure of the female urethra renders it much more capable of dilatation than the urethra of the other sex; and stones of considerable size may be removed in this manner, without the aid of any cutting instrument. If you look over the early volumes of the Philosophical Transactions, you will find that this is no new invention; but the operation had fallen into disuse, and, indeed, I may say that it had been forgotten, when it was revived by Mr. Thomas. Mr. Thomas was called to a lady, who, I know not for what purpose, had deposited an ivory toothpick, three inches long, in her bladder. He introduced a piece of sponge tent into the urethra; as the sponge swelled, the urethra became dilated, and the toothpick was then easily extracted. Since then the same operation has been performed by Sir Astley Cooper, and various other surgeons. I have myself employed this method in several instances.

In the first, I accomplished the dilatation by means of a piece of sponge tent; in the others, I made use of the dilator which Mr. Weiss has invented for this purpose, and which is undoubtedly to be preferred to the sponge tent, as it enables you to dilate the parts very gradually, and does not interfere with the free escape of the urine. None of these patients suffered from actual incontinence of urine, but one of them, in whom the calculus was of a large size, could not retain more than two or three ounces of urine in the bladder afterwards.

When you attempt the dilatation of the female urethra, I would advise you to proceed gradually. The process, however, may in most instances be completed, and the stone extracted, in less than twenty-four hours. If you use the sponge tent, it should be of that kind which is made by compressing a piece of wet sponge between two pieces of board in a vice, or under a very heavy weight, and not that prepared with wax; and the tent should be once or twice removed and renewed, in order that it may be increased in size, and also that the patient may not suffer from retention of urine.

But the method of dilatation is not to be recommended except in cases of calculi of moderate size. Where the stone is large, an incision of the urethra is necessary for its extraction; and this may be accomplished in the following manner:—Introduce a director or straight staff into the urethra and bladder, and then, by means of a cutting gorget, a common straight bistoury, or the bistouri caché, divide one side of the urethra, dilating that canal to a sufficient size for the introduction of the forceps. It has been most usual to make the incision of the urethra obliquely downwards and outwards, so as to include a small portion of the vagina. The bladder is completely within reach of the finger, and nothing can be more easy or expeditious than the method I have just described. But the patient is generally subject to the great inconvenience of an incontinence of urine afterwards. I need not tell you how important it is that such a result should be avoided. The late Mr. Hey, of Leeds, in one instance, after the operation, introduced a tent, formed of a roll of linen, into the vagina: I conclude that

this was done with a view to keep the cut surfaces in a state of apposition, and cause them to unite by the first intention; at any rate, the experiment succeeded, and the patient was able to retain her urine afterwards. I repeated Mr. Hey's experiment in a case in St. George's Hospital, but not with the same success. The patient, however, was a young and restless child: it was difficult to retain the tent in the vagina, and I do not think that, in this instance, the method was fairly tried. I have not repeated the experiment, as I have been informed that it has failed in other hands.

I was led to believe that the whole of the female urethra could be dilated easily, and to a great extent, with the exception of the external orifice; and, under this impression, in the next case which came under my care, I tried another modification of the operation. Having introduced a straight staff into the urethra, I made a small incision extending through the peculiar structure which surrounds the orifice of that canal, but no further. The wound did not extend more than one third of an inch, and was in the line of the urethra. I was then enabled gradually, and with very little force, to introduce a pair of forceps, and extract the calculus. The patient after the operation was not troubled with actual incontinence of urine. She could retain it for one or two hours, but not so long as an ordinary person. The calculus, however, in this case, was not of above an average size; and I do not suppose that the same method of operating would be found applicable to a case in which it was of large dimensions.

Soon after this I had an opportunity of trying another method of operating, which, as I was informed, had been adopted by an eminent provincial surgeon,* and which had not been followed by the usual incontinence of urine. I introduced a bistouri caché into the urethra, having previously fixed the screw in the handle of the instrument, so that the cutting edge could not be made to project more than to a very small extent; perhaps to about one sixth of an inch. Then drawing out the bistouri, with the cutting

* Mr. Hodgson of Birmingham.

edge turned directly upwards, I endeavoured to divide the membrane of the urethra immediately below the symphysis of the pubes, without allowing the incision to extend into the contiguous cellular structure. The next step of the operation was to introduce Weiss's dilator, and dilate the urethra, so as to allow of the introduction of the finger, and afterwards of the forceps, into the bladder. As the urethra now offered no resistance, this dilatation was readily effected in the course of a few minutes; and thus the stone was extracted. The patient, like the preceding one, did not suffer from actual incontinence of urine after the operation; she could not, however, retain it for so long a time as before the disease existed; I believe not longer than two hours.

But I have performed the same operation since in several other cases with a still more favourable result. In two of them I ascertained that the urine was perfectly retained afterwards. The stones, however, in these cases were of moderate size. Where the stone is large, I suspect that there is no method of removing it entire from the female bladder without an incontinence of urine, to a greater or less extent, being a consequence of the operation.

LECTURE XV.

LITHOTRITY.

Until within the last few years, lithotomy was the only method practised by surgeons for the purpose of extracting calculi from the bladder. In the year 1821, as I have already mentioned, Sir Astley Cooper first succeeded in the removal of small calculi by means of the urethra forceps. Since then a still more important addition has been made to our means of relieving patients afflicted with this malady, by the invention of an operation which has for its object to crush the calculus, and thus enable it to escape, or be withdrawn, from the bladder and urethra in fragments.

Various individuals have claimed some share of the credit of introducing this operation to the world. As long ago as the year 1775, General Martin, then a resident in India, contrived to pass an instrument through his urethra into the bladder, which he employed as a rasp, by means of which he was enabled to detach small fragments of a calculus. It was generally believed that he had succeeded in effecting a cure of his complaint. But the report was exaggerated, as is proved by the singular history of his case, published by Sir Everard Home, at the end of the second volume of his 'Observations on Diseases of the Prostate Gland.'

In the year 1817, Mr. Elderton, formerly a student in attendance on my lectures, sent for my inspection the plan of an instrument which he proposed to make with a view to this kind of operation; but, as far as I know, no such instrument was ever employed in surgery.

But whatever may have been thought, or said, or planned by others, there seems to be no doubt that the individual who first

actually practised this mode of treating calculous disorders was M. Civiale, of Paris, and to him therefore the world is mainly indebted for this great improvement in surgery.

It scarcely ever happens, however, that an invention is perfect in the first instance; and the operation which I am about to describe is not that which was introduced by M. Civiale formerly, nor which that distinguished surgeon himself practises at the present time.

Many years ago Mr. Weiss made an instrument on the principle of what I have called the sliding forceps, having a screw* attached to it for the purpose of dividing calculi, while still in the bladder, into fragments; but it was of rude construction, and such as it then was, was certainly not fitted for use on the living person.

Some time after M. Civiale had begun to practise the mechanical destruction of calculi in Paris, Baron Heurteloup engaged in the same undertaking in this country. At first he pursued M. Civiale's method of operating; but finding it liable to some very serious objections, he adopted the principle of the sliding forceps invented by Mr. Weiss, at the same time modifying its shape so as to render it more convenient for being passed into the bladder, and for seizing and retaining the stone afterwards. Besides this, he made another change in the instrument, rejecting the screw, and substituting for it a peculiar apparatus which enabled him to crush the calculus by the stroke of a hammer. Now the first of these alterations made by Baron Heurteloup I believe to have been of essential importance; in fact, without it the instrument would have remained wholly inapplicable to any useful purpose. But as to the second alteration I cannot say that anything that I have seen, either in my own practice or in that of others, would lead me to regard it as being any improvement whatever. On the contrary, all the experience which I have had would lead me to believe that in those cases, to which this operation can be properly applied,

* The application of the screw was first suggested by Mr. Hodgson, President of the Royal College of Surgeons of England, then Surgeon to the Birmingham Hospital.—C. H.

there is nothing that can be done by the hammer which may not be done quite as effectually by the screw, while the latter method is not liable to many serious objections which may be urged against the former.

It is not, however, my intention to enter into any critical discussion of the comparative merits of these two methods of proceeding. My principal object in these lectures is to give you the results of my own experience, to put you as nearly as I can do so in my own place; and I shall, therefore, without further comment, proceed to explain the steps of the operation which I have myself adopted, and which I would recommend you to practise.

The instrument made by Mr. Weiss, and which seems to me to be not capable of much improvement, consists of a very strong sliding forceps, having adapted to it a handle, in which is a screw, by means of which the forceps may be closed with sufficient force to break the calculus, which has been seized between the blades. The average length of Mr. Weiss's instrument is eleven inches exclusive of the handle. It is straight for the first nine inches, while the remaining two inches, or two inches and a half, at the extremity remote from the handle, are bent with a more sudden turn than is usual in a catheter. You will require to be provided with several such instruments of various sizes, and with some variety of shapes. For calculi of a small size the construction need not differ from that of the common urethra-forceps which I described formerly, except in the addition of the screw, and in the opposite surfaces of the blades having some small projections or teeth; but for those of a larger size you must be provided with a forceps, in the fixed blade of which there is a longitudinal slit, while there is a corresponding wedge-like projection, fitted to enter the slit, in the opposite surface of the movable blade. In using this instrument you will extract no fragments of the calculus at the time; they will drop into the bladder both laterally and through the longitudinal aperture. Besides others which I shall explain hereafter it has this advantage, that it will enable you to crush a calculus which could not be crushed otherwise, and even those of a

larger size than could, without great danger as to life, be extracted by lithotomy.

On some occasions you will require an instrument of greater length than those which I have mentioned. I have one thirteen inches long, which I had made for a patient with an enormous irreducible inguinal hernia, and in whom the common forceps would scarcely reach the neck of the bladder.

The diameter of the lithotrity-forceps may vary according to the size of the calculus and that of the urethra. As a general rule, and as a measure of security, it should be as large as the urethra will readily admit. With the same view care should be taken that the steel is properly tempered, sufficiently so to prevent it being liable to bend, and not so much as to make it brittle.

For obvious reasons, the lithotrity-forceps should be of a cylindrical form in every part, except, of course, in the handle. You will, however, find it convenient to be provided with one, the blades of which beyond the curvature are somewhat flattened, and in proportion broader than elsewhere. I saw such an instrument in the hands of M. Civiale, and have found it very useful for the purpose for which he recommends it; viz., the seizing and crushing the smaller fragments after all the larger ones have been disposed of.*

* The remainder of this lecture is omitted, as the subject of Lithotrity is fully treated of in the following paper from the 'Medico-Chirurgical Transactions.'—C. H.

NOTES ON LITHOTRITY,

WITH

AN ACCOUNT OF THE RESULTS OF THE OPERATION

IN

THE AUTHOR'S PRACTICE.

FROM THE MEDICO-CHIRURGICAL TRANSACTIONS FOR 1853.

Although the operation of lithotrity has been for many years extensively and successfully practised in a neighbouring country, it has hitherto been adopted only to a limited extent by British surgeons; yet, if I may be allowed to judge from the results of my own experience of it, it must be regarded as a method of relieving those who suffer from calculus of the bladder which is attended with much less uncertainty and danger—being at the same time much less formidable to the patient—than the operation of lithotomy. With the strong conviction which I have of these advantages, I do not hesitate to comply with the desire lately expressed by our president, Dr. Copland, and formerly by his predecessor, Mr. Hodgson, that I would bring the subject before the Royal Medical and Chirurgical Society. In doing so, however, I do not presume to trouble the Society with anything like a systematic treatise on lithotrity. The object which I have in view will be better obtained in a less formal way; and I propose, first, to communicate, in a series of notes, some observations as to those circumstances which are especially deserving of attention, as affecting the success of the operation; secondly, to give a brief

but accurate account of the actual results which I have met with in my own practice, from the time when I first performed the operation, down to the present period; and, lastly, to add some observations as to the amount of danger involved in the removal of calculi by crushing compared with that which belongs to lithotomy. I can have no better opportunity than the present of offering such a communication, as, having for some time declined the operative part of my profession, it is not probable that any further delay will enable me to make any very important additions to whatever knowledge of the subject I now possess.

Section I.

1. I have never performed the operation in young persons below the age of puberty. The operation of lithotomy in the cases of children is so generally successful, that it has not appeared to me that, as to them, any deviation from the old method of treatment is required; while, on the other hand, the small capacity of the urethra, and the difficulty which must attend the introduction of a forceps sufficiently large to crush a calculus of any considerable size, seems to render them unfit subjects for lithotrity.

There is another very sufficient objection to the last-mentioned operation in children; namely, that, instead of being completed at once, as in the instance of lithotomy, it is for the most part necessary that it should be repeated several times, and that such a repetition requires a degree of patience and self-control, and thought of the future, which children can scarcely be expected to possess.

2. I have not myself performed the operation of lithotrity on females. That I have not done so has arisen partly from the circumstance that in them cases of calculus of the bladder are rare as compared with those which occur in the other sex; partly from the facility with which the female urethra may be dilated so as to admit of the extraction of a calculus of moderate size; and partly from the belief that the bladder would not easily retain the quantity of water necessary to the safety of the operation. I am, however,

inclined to believe that as regards the last-mentioned objection I have been in an error, as Mr. Fergusson informs me that he has crushed calculi in the female bladder without difficulty, and with perfect success.

3. The forceps which I have been in the habit of using is that made by Weiss, with a handle sloping downwards, and a simple screw. For ordinary cases, a forceps of very moderate size is sufficient; for cases of very large calculi it is prudent to use a larger and a stronger instrument. I have never met with a single instance in which, however large it might be, a calculus once seized by the forceps did not yield readily to the pressure of the screw; or in which any harm happened from the bending or breaking of the instrument. I have lately seen a forceps in which the force intended for crushing the calculus is applied by means of a short cylindrical rod, introduced laterally, with some projecting teeth acting on a rack on the anterior part of the sliding blade. Such an instrument may afford some small advantage in the way of greater expedition, and so far may not be objectionable in cases of very small calculi; but it is evident that, as compared with the forceps with a screw, it must be very deficient in power, and that it would be very unsafe to have recourse to it in cases of calculi beyond certain dimensions.

4. The peculiar shape of the extremity of the forceps (without which it would not answer the intended purpose) renders it less easy to be introduced into the bladder than an ordinary sound or catheter, and a certain degree of force is generally required to enable it to pass through the urethra where it is surrounded by the prostate gland, such as is not at all necessary in using either of the last-mentioned instruments. The manœuvre necessary for this purpose cannot well be described in words, but it is easily acquired, and it may be learned by practising on the dead quite as well as by practising on the living body. It is only in cases of considerable enlargement of the prostate gland that any real difficulty in the introduction of the forceps exists: but even in such cases I have never met with an instance in which the difficulty was not

overcome by a cautious and gentle manipulation, nor with any in which any injury was done to the neck of the bladder in this part of the operation.

In using the forceps it is important that no attempt should be made to open the blades until the sudden cessation of the resistance offered by the prostate gland shows that they have fairly entered the bladder. The blades may be partially separated while a portion of the curved extremity is still in the urethra; but a certain effect of this is that the patient is subjected to much unnecessary pain, at the same time that there is great danger that the injury thus done to the verumontanum and orifices of the seminal ducts may induce inflammation of one or even of both of the testicles.

5. No prudent surgeon would willingly undertake the operation unless the bladder admitted of the injection and retention of from at least four to six ounces of tepid water. In cases in which the bladder has lost its power of retention, it may generally be restored by keeping the patient for a week or fortnight in the recumbent posture, and at the same time injecting some tepid water once daily into it. This method has failed with me only in a single instance. In consequence of the failure, I had recourse to lithotomy, and extracted a very large calculus, composed of the oxalate of lime, with angular projections on its surface, which sufficiently explained the irritable state of the bladder. The patient died in a few days after the operation.

Although, as has been just observed, the operation should never be attempted without the bladder having been previously distended with tepid water, it is worthy of notice that it has occurred to me sometimes to find that during the operation the whole of the water which had been injected had escaped by the urethra, without my being at the time aware of the circumstance; so that many fragments must have been crushed in an otherwise empty bladder. On such occasions I have always been apprehensive lest some ill consequences should ensue. It is true that this did not happen in any one instance; still it is a thing that ought to be carefully avoided,

as it is plain that any but the most careful manipulation with the forceps would be dangerous under these circumstances.

6. The most important part of the operation is undoubtedly that of seizing the calculus with the forceps; and this may be dangerous and difficult, or safe and easy, accordingly as the surgeon is or is not acquainted with the right method of proceeding.

The rule should be to *move the forceps in the bladder as little as possible*, never using it as a sound for the purpose of exploring the bladder, or ascertaining the position of the calculus. Such an examination does not assist the surgeon in seizing the calculus afterwards; it gives pain to the patient, excites the bladder to contract and expel the water which had been previously injected; and I know that instances have occurred, though not in my own practice, in which a rough handling of the forceps has caused great injury to the bladder, ending in the death of the patient. The rule for seizing the calculus (which I must acknowledge to have first learned from witnessing the very dexterous operations of M. Heurteloup) is as simple as possible. The patient lying on his back, the handle of the forceps is elevated, which of course brings the convex part of the curved extremity of it in contact with the posterior surface of the bladder, where it is contiguous to the rectum. The forceps is then to be opened, by withdrawing the sliding blade to a greater or less extent, according to the probable size of the calculus, the fixed blade being at the same time pressed gently downwards, in the direction of the rectum. The object of this manipulation is, that the forceps, being below the level of the other parts of the bladder, the calculus may fall into it by its own weight; and it is generally successful. If it should not do so, the forceps, without being moved from its situation, may be gently struck with the hand on one side, or on its anterior part, and the slight concussion thus communicated to the bladder will probably be sufficient to dislodge the calculus, and bring it within the grasp of the instrument. If it should be otherwise, the forceps, being closed, may be very gently and cautiously turned to one side or the other, so that the curved extremity of it may make an angle of twenty-five or even thirty

degrees with the vertical line of the body, then opened, and pressed in the direction of the rectum in the manner already described.

When the prostate gland is much enlarged, there is sometimes a difficulty in seizing the calculus, arising either from it lying under that part of the gland which projects into the bladder, or from the impediment which it offers to the elevation of the handle of the instrument. For such cases the operating table invented by M. Heurteloup, which enables the patient's shoulders to be suddenly lowered, is very convenient; or the same purpose will be answered sufficiently well if the patient be placed on a light sofa, the end of which may be raised by an assistant. The calculus is then seized, not in that part of the bladder which adjoins the rectum, but in the fundus, this being rendered the lowest point by the elevation of the pelvis.

If the calculus does not at once drop into the blades of the forceps, the patient may be directed to walk round the room, or to change his position as he lies, by turning first on one side and then on the other, the bladder being afterwards emptied by the catheter, and then again injected with tepid water. By these means the calculus is made to change its position, and may often be readily seized, though it could not be so previously.

7. In the early part of my practice I was accustomed to use a forceps so constructed that a greater or smaller portion of the crushed calculus was always retained between the blades. In this way a considerable quantity of calculous matter may be removed at each operation, and the patient may, to a great extent, be saved from the trouble of passing it afterwards with the urine. There are, however, some very grave objections to this mode of proceeding. The withdrawing of the forceps, if much loaded with calculous matter, stretches the urethra beyond its natural diameter, and in so doing not only gives the patient much pain at the time, but renders him liable to rigors afterwards; secondly, in four instances in which I had adopted this practice, the urethra was torn, and an infiltration of urine into the surrounding tissues,

followed by urinary abscess, was the consequence. Two of these patients, in whom the mischief produced was deep in the perineum, died, notwithstanding the abscesses having been freely opened as soon as they were detected.

The experience of these cases led me some years since to discontinue the use of the forceps already referred to, or, at least, to have recourse to it very rarely, and only under some special circumstances, and to substitute for it a forceps made by Mr. Weiss, in which there is a longitudinal opening in the curved part of the fixed blade, with a corresponding projection in the opposite or sliding blade. The effect of this instrument is to crush a calculus very completely, and in such a way that no part of it remains between the blades, the whole being left to be passed with the urine afterwards. The ultimate cure of the patient may, in some instances, be thus a little (but not greatly) protracted; but this inconvenience is more than compensated by the smaller amount of pain which the patient suffers, the smaller liability to rigors, and the complete absence of danger from the infiltration of urine and perineal abscess.

8. An important question arises, to what extent may a calculus be crushed at one operation? In the dead body the largest calculus may at once be reduced to atoms; but it would be very unsafe to attempt to do this in the living person; first, the time during which the bladder will retain the water injected into it is limited —and, for the most part, it begins to escape in a few minutes after the introduction of the forceps; secondly, the only part of the operation during which the patient much complains of pain is the instant of the attempt being made to seize the calculus, the pain then evidently arising from the pressure of the forceps on the neck of the bladder. Now I have observed that where the crushing of the calculus had been, during one operation, very frequently repeated, more or less inflammation has always followed, extending from the neck of the bladder to the mucous membrane, causing a great mucous secretion, and preventing a repetition of the operation for a considerable time afterwards; and hence I have come to the

conclusion that it is a more prudent, and in the end a more expeditious mode of proceeding, to be content, on any one occasion, with crushing the calculus only to a moderate extent. At the same time, it is plain that no general rule can be laid down as to how much can be prudently accomplished. The surgeon must use his own discretion, being guided chiefly by the amount of inconvenience which the patient suffers. In one case, twelve or fifteen fragments may be safely crushed, in another not more than six or seven. The consideration of what has now been mentioned leads me, on the whole, to prefer not putting the patient under the influence of chloroform, as it prevents the patient from describing those sensations which may help to direct the surgeon in his practice.

9. There is another reason for not being anxious to do all that can possibly be done at any one operation, namely, the greater liability that this occasions of the operation being followed by a rigor. For the same reason it is important that the urethra should not be stretched beyond its natural diameter, either by the use of very large instruments or by the withdrawing of the forceps loaded with the fragments of the calculus. It may be necessary in a few cases that a very narrow urethra should be dilated, but this should be gradually accomplished by the introduction of bougies, the operation itself being deferred until the dilatation is completed. In all cases, however, there is more or less risk of the occurrence of a rigor unless due precautions are taken to prevent it. With this view, I always advise that the patient should go to bed afterwards, with an additional blanket over him, the bed itself being previously warmed in cold weather. I was accustomed formerly to prescribe a dose of the Pulvis Ipecacuanhæ Compositus, or some other opiate, to be administered after the operation. For the last few years, however, I have preferred giving the patient a tumbler of hot wine and water, or brandy and water. It seems to me that this is more effectual in preventing a rigor than the opiate, at the same time that it has the advantage of not inducing costiveness or headache afterwards.

I need scarcely add that it is important on all occasions that

nothing should be omitted which may tend to lessen the liability to rigor. Even in the most healthy persons it is followed by more or less depression of the vital powers, and prolongs the interval which must elapse before the operation can be repeated; while, under certain circumstances, when calculus of the bladder exists, in combination with other disease, it may be actually dangerous to life. I shall have occasion to refer to this subject in reference to the complication of renal disease hereafter.

10. When a calculus has been crushed of so small a size that two or three applications of the screw were sufficient for that purpose, it may be that the fragments will be immediately passed with the urine, so that the bladder may be quite free from them, and the cure of the patient completed in the course of two or three days. When, however, it has been necessary at any one operation to repeat the crushing process several times, for the most part very few of the fragments, and sometimes none at all, are passed during the first three or four days, or it may be even for a week. The explanation of this I apprehend to be, that the pressure of the forceps on the neck of the bladder, which I have already mentioned as the principal inconvenience to the patient at the time of the operation, occasions some degree of inflammation and tumefaction of the prostate gland afterwards, sufficient to prevent the escape of the fragments in the first instance. That nothing may interfere with the neck of the bladder recovering its natural condition, it is desirable that the patient should remain quiet for the first two or three days on a sofa. Afterwards, with a view to the more free discharge of the fragments, I have generally advised him to walk gently about the house, or even a short distance out of doors, during a part of the day, and to drink plentifully of barley-water or some other diluting liquor. At the same time all violent exercise, such as rapid walking or running, should be avoided, as it might occasion the urethra to be blocked up by the too rapid escape of the fragments from the bladder. The patient, in some instances, suffers a good deal of inconvenience from a fragment of the calculus being lodged in the urethra, especially in the membranous part of

the canal. Various kinds of forceps have been contrived for the purpose of removing the fragments under these circumstances, and I have in two or three instances used them with advantage where a calculus had been lodged in the space between the glans and the scrotum. I cannot say that the forceps may never be required where a fragment is lodged in the posterior part of the urethra, or even that it may not be necessary to extract it by an incision in the perineum. Such a case, however, has not occurred in my own practice. It so happens that I have always succeeded in dislodging the fragment by two or three times introducing a rather small elastic gum catheter, and thus altering the position which it occupied in the urethra. I may take this opportunity of observing that it is very important to avoid cutting down on the urethra immediately in front of the scrotum. In two instances in which I thus removed a calculus, not after crushing, but where it had been extracted from the bladder entire, by the method proposed formerly by Sir Astley Cooper, notwithstanding the immediate introduction of an elastic gum catheter and the retention of it in the bladder, a small quantity of urine found its way into the cellular tissue of the penis and scrotum, causing a series of troublesome abscesses afterwards.

In an elderly person, in whom there is usually more or less enlargement of the prostate gland, the fragments do not come away so readily as in those who are younger. This especially happens where the patient has lost the power of emptying the bladder by his own efforts. It would be a mistake, however, to suppose that the incapability of expelling the whole of the urine prevents them from coming away altogether: still the process is more tedious, and requires some assistance beyond that which is required under ordinary circumstances. Firstly, the patient should be directed to void his urine stooping forwards, or even in the recumbent posture, lying with his face downwards. Secondly, tepid water should be injected by means of a syringe, or elastic gum bottle, through a large silver catheter, having a wide aperture near its extremity on the concave side, by which means fragments below a certain size

may be washed out of the bladder. This may be done daily, the injection being repeated on each occasion three or four times. In one instance, in which a complete retention of urine followed the crushing of a large calculus, in the course of two or three weeks the whole of the fragments were thus brought away, the patient regaining the power of emptying the bladder afterwards.

11. Where the presence of a calculus has excited inflammation of the mucous membrane of the bladder, indicated by excessive irritability of that organ, and a copious secretion of mucus from its membranous surface, I have generally deemed it prudent to defer the operation for a time, the patient remaining at rest in the recumbent posture until the inflammation has in some degree subsided. This state of things, however, unless the inflammation is excessive, does not form an absolute objection to the operation, though it may be a reason for proceeding more cautiously than if the bladder were in a perfectly healthy state. Indeed it often happens that the first crushing of the calculus, by distributing its weight over a large surface of the bladder, is followed by a marked improvement of the symptoms, the pain which the patient suffers being immediately diminished, and the mucous secretion reduced in quantity.

In the great majority of instances the crushing of a calculus may be repeated at moderate intervals, without any signs of inflammation, or any very large secretion of mucus being induced. In other instances it is quite otherwise. This may depend on circumstances altogether beyond our control, some individuals being more and others less susceptible of inflammation. Much, however, depends on the operator. I have already observed that if, from an over-anxiety to obtain a speedy cure, the operation on any occasion be much prolonged, the probability of such ill consequences is much increased; and I need scarcely add, that the same result is to be expected from any rough manipulation with the forceps.

12. It has been objected to this mode of removing calculi that there is always a risk of a fragment remaining in the bladder, and causing a recurrence of the disease; and it is quite true that this

may well happen without great caution and vigilance on the part of the operator. A single small fragment may escape detection, however carefully the examination of the bladder may be conducted, especially where there is any considerable enlargement of the prostate gland. Still it may be detected at last, and the patient should not be finally dismissed as cured while any of the symptoms of calculus of the bladder remain. It has happened to me, in three different instances, to make more than one most careful examination of the bladder, without discovering a fragment which has at once fallen within the grasp of the forceps, when the examination has been repeated a few weeks afterwards. I may take this opportunity of observing, that where the calculus, or fragment of a calculus, is of a small size, the forceps affords a much more certain means of exploring the bladder than the common sound or catheter, the latter instruments being, in fact, very inefficient for this purpose.

In a case of diseased and sacculated bladder, it is plain that a fragment lodged in one of the sacculi, not only cannot be crushed, but may escape detection altogether. One such case has occurred in my own practice. A gentleman laboured under a calculus of the bladder, complicated with an enlargement of the prostate gland, which prevented his emptying the bladder by his own efforts, and made the constant introduction of the catheter necessary. The calculus had been crushed, but much irritation of the bladder remained, which I was led to attribute to the disease of the prostate gland. After some months the patient died, and the body was examined by Mr. Bowling, of Hammersmith, who found the prostate gland much enlarged; abscesses in the kidneys; a fasciculated and sacculated bladder, and a fragment of the calculus impacted in one of the sacculi.

13. There is some difference in the operation in different cases, depending on the chemical composition of the calculus. A calculus composed of oxalate of lime requires a greater force to crush it than one of the same size composed of lithic acid. It is important that one of the former kind should be crushed as completely as

possible, as otherwise the urethra is liable to be irritated by the sharp angles presented on the surface. A calculus composed of the triple phosphate, or of the mixed phosphates, or more especially of the pure phosphate of lime, is more easily crushed than one of lithic acid; so that if of a small size the mere pressure of the thumb will often be sufficient, without the application of the screw. When there is disease of the bladder, with a constant exudation of adhesive alkaline mucus from the lining membrane, phosphate of lime is continually being deposited in small masses like a soft mortar, which, if allowed to remain, become aggregated, and form the nucleus of a large calculus. It is important that such a result should, if possible, be prevented. I have elsewhere published an account of a case of this description,* in which a very large accumulation of deposits of this soft phosphate of lime had taken place, causing great suffering to the patient, but which I was enabled to remove by means of a forceps having the fixed blade made concave, so as to answer the purpose of a scoop, without the use of the screw; the bladder being regularly washed out afterwards to prevent any further accumulation from taking place.

14. That which I have just mentioned belongs to a class of cases in which a cure of the disease is out of the question; and in which the operation of lithotomy would be attended with so much danger that no prudent surgeon would undertake it; but in which, nevertheless, great advantage may be obtained by the use of the lithotrity-forceps. In the cases to which I refer there is a permanent and incurable disease of the bladder, induced originally by a tumour of the prostate gland projecting into it, or in some other way, the calculous matter being deposited, not by the urine, but by the secretion of the mucous membrane. When collected in a certain quantity, by irritating an inflamed and highly sensitive organ, it becomes a source of most intense suffering far beyond what occurs in ordinary cases of calculous disease. We have, for the most part, no means at our disposal, by which, in such cases, the deposit of the phosphate of lime can be altogether arrested:

* Lectures on the Diseases of the Urinary Organs, 4th edition, p. 301.

but, by watching the patient carefully, and removing from time to time the small calculi as they are generated, the sufferings which they would otherwise produce may be mitigated or prevented. Two or three such cases have occurred in my own practice, in which I was enabled, not ultimately to preserve, but to lengthen, the patient's life, and so that he passed the remainder of his days not in a state of absolute ease and comfort, but with a far less amount of suffering than would have been the case otherwise.

15. It is not uncommon for the operation to be productive of a slight hæmorrhage, sufficient to discolour the water drawn off from the bladder, or even the urine, for two or three days afterwards. The blood seems to proceed from the neck of the bladder, and probably arises from the pressure made by the forceps on the prostate gland in the act of seizing the calculus. I have never, in my own practice, met with hæmorrhage to any considerable extent, or such as to interfere with the progress of the cure. It is plain, however, that in a case of enlarged and very vascular prostate gland a greater hæmorrhage might occur under the most careful treatment: otherwise its occurrence must be regarded as evidence of the forceps having been too roughly used, without that degree of caution and lightness of hand which I have already mentioned as being absolutely necessary to the success of the operation.

16. The advantages of lithotrity are certainly most conspicuous in cases of small calculi, where a cure may be effected by one or two operations, so that the patient, in the course of four or five days, finds himself free from the pain and anxiety belonging to a most formidable disease, and able to resume his usual occupation. There are undoubtedly cases in which the magnitude of the calculus is such that it would be impossible to seize it with the lithotrity-forceps, or to crush it if seized, and in which the patient is reduced to the alternative of a miserable death from the disease, or of taking the very small chance which, under such circumstances, lithotomy affords him of a cure. Such cases, however, are, according to my experience, rare exceptions to the general rule; calculi of very considerable dimensions may be crushed with ease

and safety. I have, in some instances, when the calculus was seized, found that the blades of the forceps have been separated to the extent of an inch and a half, yet have found no difficulty in the operation, nor any other inconvenience than that of having to repeat it oftener than when the calculus was of smaller diameter. In the year 1844, in a case which the late Mr. Aston Key attended with me in consultation, from the length of time during which the symptoms had existed, and from such examination as we were able to make, we were led to apprehend that the calculus might be of so large a size that crushing it would be impracticable. However, we determined that the operation should be attempted. I had a forceps made for the purpose, larger and of greater power than those which I had previously used, and we were agreeably disappointed to find that it yielded at once to the force which I was thus able to apply, the fragments being afterwards gradually reduced by means of the ordinary instruments.

It must be observed, however, that where we have recourse to this operation it is difficult to determine the exact size of the calculus. We have no means of knowing whether it be seized in its longest or in its shortest diameter. The fragments which come away may be preserved and weighed, but these are no measure of what is actually destroyed, as many of the smaller fragments may be entangled and lost in the mucus, and so much of the calculus (especially where it consists of the phosphatic salts) is always reduced to a state of impalpable powder, which renders the urine opaque, but is otherwise imperceptible to the eye, though it may be detected by chemical analysis.

Section II.

Having made these observations as to the points which principally demand the attention of the surgeon, in connection with the operation of lithotrity, and having offered those suggestions which, according to my experience, are most important with a view to its favourable termination, I shall endeavour to communicate to the Society, as nearly as I can, an exact account of the actual results

of my own practice. In doing so it will be my especial object to describe, however briefly, the cases in which the operation, in my hands, has proved to be unsuccessful, and the causes which have led to its failure. I have the means of doing this with sufficient accuracy, as I have the advantage of referring not only to my own notes, but to those of my friend and former pupil Mr. Charles Hawkins, who has assisted me for many years past in the great majority of cases which have come under my care, and has preserved notes of every one of them.

From these two sources I obtain an account of 111 cases. There are a few others of which I have no written memoranda; and these being scattered over a period of twenty years, I cannot charge my memory with an accurate recollection of them. They are probably as many as nine or ten; but that I may not incur the risk of magnifying the extent of my experience, I will set down the whole number of cases under my care as being no more than 115. I am aware that this is a small number compared with those which have been treated by my friend M. Civiale, and some other surgeons in Paris, who devote themselves especially to this branch of our profession. It is, however, I apprehend, quite sufficient to enable any one who is a careful observer to make himself acquainted with all the more important points of practice.

When I speak of having performed the operation in 115 different cases, I do not mean to say that these occurred in the same number of individuals. One great advantage which this operation has over that of lithotomy, is that, being less formidable to the patient, he is not unwilling to undergo it again and again if there should be such a liability to calculous disease as to render it necessary. There was a gentleman whom I attended, in conjunction with the late Dr. Prout, in whom the tendency to the deposit of lithic acid was so great that none of the methods commonly in use, nor any others which we were able to devise, had any sensible influence over it. Originally the deposit had been in the form of lithate of ammonia, the surface of the vessel being always stained of a red colour. Afterwards it assumed that of renal calculi. Several of

these were voided from time to time, while others, being of greater magnitude, remained in the bladder, and required to be crushed. The operation was performed on this patient as many as eight times in the course of the same number of years, always with complete success. He died at last the victim of cerebral disease;—a not uncommon termination of those cases in which there is so great and uncontrollable a disposition to the production of lithic acid in the blood. In another patient, who was also under the joint care of Dr. Prout and myself, there was a similar liability to the formation of renal calculi; but they were generally of a small size. I removed at various times, probably more than one hundred calculi of the size of hemp-seeds, by means of the scoop-forceps; but on two or three occasions, the calculi being of a larger size, it was necessary to crush them. In three other cases I had to perform the operation a second time. It is to be observed that I refer here to cases in which there could be no doubt that the calculi were altogether fresh formations, and that I carefully exclude the very few instances that have occurred to me, in which a recurrence of the symptoms might be reasonably attributed to some fragment or fragments having been overlooked in the first instance.

It would be needless to enter into the details of the very large majority of cases which have been under my care, the patients having obtained complete and permanent relief without any dangerous symptoms or other ill consequences. Those which form an exception to this general rule, may be distributed under the following heads:

First. Cases in which there was a fatal result, arising solely from the operation itself.

Secondly. Cases in which a similar result was to be attributed to the coexistence of some other disease, brought into an active state by the shock of the operation, but which disease would in itself have been sooner or later the cause of death, even if the operation had not been performed.

The cases which belong to the first of these divisions are five in number.

I have already referred to four cases, which occurred in the early part of my practice, in which the urethra had been lacerated in withdrawing the forceps loaded with calculous matter. In two of these the patients died.

In one of them, urinous effusion took place behind the triangular ligament of the perineum, causing extensive sloughing of the cellular membrane in the immediate vicinity of the prostate gland and neck of the bladder.

In another case, the effusion took place in the perineum behind the scrotum. As soon as it was discovered the perineum was freely divided; but great constitutional disturbance followed, attended with acute inflammation of the lining membrane of the bladder, and an immense secretion of adhesive mucus, under which the patient sank and died.

In a third case, a calculus of very moderate size was crushed without the smallest difficulty. The operation was followed by a rigor, which, not being relieved, as is usual, by a perspiration, terminated in an attack of fever, and ultimately in the patient's death. There were no local symptoms whatever; the bladder being free from irritation; the urine remaining acid, free from mucus and pus, and there being no indication of renal disease. It certainly may have been otherwise, but it seems to me that the circumstances are best explained by supposing that the febrile disturbance of the system, of which the rigor was the precursor, was the actual cause of death. Unfortunately, the objections of the patient's friends to a post-mortem examination, prevented my having the opportunity of obtaining any positive information on the subject.

In a fourth case, a very small calculus was crushed with great ease by a single operation. The operation was succeeded by a rigor, which terminated, as is usual, in a perspiration. A disturbed state of the system followed, marked by a frequent pulse, a furred tongue, and much prostration of strength; and attended with a

deposit of adhesive mucus, but not in large quantity, from the urine. These symptoms continued, and after some time an abscess presented itself in one groin. The abscess having been opened, a considerable discharge of matter took place, and was followed by great relief as to the general symptoms. The patient seemed to be in an improving state, when, between four and five weeks after the operation, he suddenly expired.

On examining the body, no remains of the calculus were discovered in the bladder. The mucous membrane of the bladder bore marks of inflammation. There was an abscess of the pelvis occupying the space between the bladder and rectum, and extending in the direction of the abdomen as high as the groin, in which the puncture had been made. The parts were carefully dissected and examined by the late Mr. Vincent (who had attended the patient with me in consultation), by Mr. Charles Hawkins, the Curator of the Museum of St. George's Hospital, and myself, but no lesion could be detected of the bladder, nor any kind of communication between the bladder or urethra and the abscess. Still I cannot doubt that the abscess was somehow the result of the operation. Probably a very small splinter of the calculus might have penetrated the coats of the bladder, allowing the escape of a very minute quantity of urine into the cellular membrane. This would be quite sufficient to account for an extensive suppuration, at the same time that it is easy to suppose that so small a puncture might at once have closed, so as to be invisible afterwards.

The fifth case was that of an elderly gentleman, in whom, after a calculus had been twice or three times crushed, inflammation of the mucous membrane of the bladder ensued, attended with little pain, but with a very large secretion of mucus, and great prostration of his bodily powers, under which he gradually sank and died.

In the three cases which follow, there seems to be no reason to doubt that the fatal result, though it immediately followed the operation, is more to be attributed to the existence of renal disease than to anything in the operation itself. Still, as in each of them the patient might have lived longer if it had not been had recourse

to, we must admit them as examples of the operation being unsuccessful.

In one of these cases the patient, though apparently in good health otherwise, had been for some time liable to attacks of severe pain in the loins. A calculus, of a moderate size, was crushed without any difficulty, some of the fragments being withdrawn with the forceps afterwards. The operation was followed by a rigor. On the following day there was an attack of most intense agonising pain in the loins, attended with a very frequent pulse, which lasted for several hours, and could be relieved only by opium. Several attacks of the same kind succeeded each other at various intervals, one of them being ushered in by another severe rigor. At first, on the pain subsiding, the pulse returned to its natural standard; afterwards there was no remission of the febrile symptoms; the patient was alternately drowsy and delirious. He gradually sank, and died twelve days after the operation.

The body was examined, with the assistance of Mr. Henry James Johnson, who attended the patient with me.

Some fragments of the calculus which had been crushed, with three or four other calculi of a small size, were found in the bladder. The bladder and urethra and parts immediately in connection with these were in a perfectly healthy state.

The left kidney was enlarged to nearly double its natural size, and of a dark red colour, from excessive vascularity. The investing membrane adhered more closely to the surrounding adeps than to the kidney itself. When it had been removed, numerous small deposits of straw-coloured lymph were found interposed between it and the glandular structure. The mucous membrane of the pelvis and infundibula was inflamed, and contained a considerable quantity of muco-purulent fluid. There was no disease of the right kidney.

Another case was that of a gentleman who, besides the usual symptoms of calculus of the bladder, suffered from the effects of an enlargement of the prostate gland, which prevented him from being able to empty the bladder by his own efforts. The urine,

when drawn off by the catheter, was turbid, and deposited some mucus afterwards.

After the first crushing of the calculus the patient had a rigor, which, however, was followed by no ill consequence. The bladder was emptied at regular intervals by means of a catheter having a large aperture, at the same time being washed out daily with tepid water. In this manner a large quantity of the broken down calculus, consisting of the mixed phosphates, was brought away.

The operation was not repeated until after the expiration of a fortnight. It was again followed by a rigor, and by another on the succeeding day. From the effects of this last rigor the patient never recovered; and he died on the third day after the second operation.

On examining the body after death, the prostate gland was found enlarged, and forming a tumour, projecting into the bladder of the size of an ordinary plum.

The mucous membrane was rather more vascular than under ordinary circumstances, and the muscular tunic was somewhat increased in thickness, but not more so than in most other cases of enlargement of the prostate gland. In other respects the bladder and urethra were in a sound state.

The kidneys were of a dark red colour, from excessive vascularity; and, on separating the investing membrane, numerous small deposits of pus were found beneath it imbedded in the glandular structure.

In the following case as long a period as six weeks elapsed between the last operation and the death of the patient; nevertheless, I cannot do otherwise than refer it to the same class as the two preceding, as, although he laboured under a disease from which he could not have ultimately recovered, we must suppose that the fatal termination of it was hastened by the operation.

The patient was under my care in St. George's Hospital, labouring under calculus of the bladder, complicated with general ill health, but at first having no symptoms indicating any immediate danger. The calculus was crushed by five operations, at intervals varying from five to thirteen days. During this process he had

several severe rigors. From the time of the last operation he was free from pain, but the urine was alkaline, depositing a good deal of adhesive mucus, with great general debility, increasing until he died.

On examining the body, one kidney was found to be enlarged to double its natural size, with numerous abscesses, from the size of a pin's head to that of a pea, imbedded in the glandular structure. The mucous membrane of the pelvis and infundibula bore marks of inflammation, and was encrusted with phosphate of lime. The opposite kidney exhibited similar marks of disease, but to a less extent. The prostrate gland was a good deal enlarged; the mucous membrane of the bladder was inflamed, and the muscular tunic thickened.

As it is my wish to give an exact account of the results of my own practice, I shall add to this list of casualties a notice of another case in which the death of the patient took place shortly after the operation; but under circumstances which make it at the least very doubtful whether the operation had in any way contributed to it. The patient was an elderly gentleman, and the calculus was of a large size. It was crushed without any difficulty, but several operations were required, occupying altogether a period of three or four weeks. No unfavourable symptoms presented themselves, except that the patient, who was naturally of what is called a nervous temperament, was on the whole in a desponding state of mind, taking an unfavourable view of his own condition. However, he seemed to have perfectly recovered, and had begun to resume his usual habits, when he was seized with a severe attack of diarrhœa, which did not yield to the usual treatment, and after a few days proved fatal.

Mr. Keate had seen the patient with me in consultation, and Mr. Charles H. Johnson had assisted me in the various operations, and in my absence from London, they examined the body without finding any morbid appearance except that one kidney was somewhat larger and more vascular than under ordinary circumstances.

I am not aware that among the cases which have been under my care, there have been any besides those which have been now enumerated, in which the operation can be considered as having either caused or accelerated the patient's death. In by far the greater number of instances the entire destruction of the calculus is immediately followed by relief from all the former symptoms, the bladder being no longer irritable, and the urine being free from mucus. It occasionally happens, however, that after the cure is completed, or supposed to be completed, the mucous membrane of the bladder remains in a more or less inflamed state, indicated by a frequent desire to void the urine, and a deposit from the latter of adhesive mucus. This may arise from a fragment of the calculus having been overlooked, in which case the symptoms will continue until such fragment has been detected and crushed. It may arise also from the calculous disease having been complicated with disease of the prostate gland, or of the bladder itself; and it is, moreover, one of the numerous ill consequences of a too rough manipulation on the part of the surgeon, or too long protracted operations. The symptoms here referred to, if merely the result of the operation, generally subside in the course of a fortnight, with little other treatment than that of keeping the patient in a state of repose, and chiefly in a recumbent position on a sofa.

Section III.

It would be unreasonable to expect that any method of treatment for the relief of a disease so certainly fatal if left to itself, and productive of so much misery, as calculus of the bladder, should be constantly and uniformly successful. If lithotomy has its dangers, lithotrity has its dangers also; and the only question for the practical surgeon to consider, is, which is the least dangerous of the two. Of the nine cases which I have enumerated it may well be doubted as to one of them whether the attack which was the immediate cause of the patient's death was really connected with the operation; while in two others, the fatal result was to be

attributed to a mode of performing the operation which my later experience has led me to abandon. But, even if we admit the whole nine cases as a fair example of the average failure of the operation, the proportion of deaths to recoveries is somewhat less than 1 in $12\frac{1}{2}$.

In order that I might compare this with the proportion of deaths from lithotomy, I have referred to a paper by the late Mr. R. Smith, of Bristol, published in the Eleventh volume of the 'Transactions' of this Society, and entitled *An Inquiry into the Statistics of Stone in the Bladder*, and I there find it stated, that in the Bristol hospital, during a series of many years, the average of deaths after lithotomy was 1 in $4\frac{1}{2}$; in the hospital at Leeds, 1 in 5; and in the hospital at Norwich, 1 in $7\frac{1}{4}$.

Thirty-five years have elapsed since the publication of these statements, but there is no reason to believe that the success of lithotomy is greater now than it was when Mr. Smith collected his observations. The editor of a weekly journal (the 'Medical Times and Gazette') has for some time past published the statistics of the various operations performed in the London hospitals, including lithotomy. The facts seem to have been collected with some care, and are probably a near approximation to the truth. Mr. Charles Hawkins has been at the pains to collect from the various numbers of that journal published during the year 1854 the facts relating to lithotomy, and it appears that of 59 patients who underwent that operation as many as ten died, being in the proportion of rather more than 1 in 6.

But here two other facts must not be overlooked, without which no just comparison can be made of the results of the two operations. First, while cases of vesical calculus in children under the age of puberty, in private practice, and among the more affluent classes of society are of rare occurrence, they form the very great majority of those which are admitted into hospitals; and, secondly, the proportion of deaths after lithotomy among children is very much less than it is among adults. Both these facts are sufficiently obvious to those who have had the opportunity of witnessing the

practice of our larger hospitals. From the data furnished by the medical journal to which I have already referred, it appears that in the London hospitals during the last year children formed a small fraction more than three-fourths of the whole number of those who underwent lithotomy; that among them the deaths were in the proportion of 1 to 14 recoveries; while among adults the deaths and recoveries were equal. That in this instance the large proportion of deaths among adults was beyond the average, and depending on accidental circumstances, cannot well be a matter of doubt, and indeed it is plain that no general rule can be drawn from the limited number of cases which occur in the space of a single year. Still, as even in the Norwich hospital, where there is reason to believe that lithotomy has been on the whole more successful than in any other public institution, the proportion of deaths among adults is reported to have been four times as large as that among children, it is evident that the difference in the degree of danger at these two periods of life is very great; and it must always be borne in mind that, in estimating the comparative value of the two operations, it is only the results met with in adults that should enter into our calculations.

My own experience has certainly led me to the conclusion that lithotrity, *if prudently and carefully performed, with a due attention to minute circumstances*, is liable to a smaller objection than almost any other of the capital operations of surgery. The cases to which it is not applicable are very few indeed, and they are chiefly those in which, from the calculus having attained an unusual size, the danger and difficulty of lithotomy are so great, that no surgeon would willingly, nor otherwise than as a matter of duty, undertake it.

END OF THE SECOND VOLUME.

LONDON
PRINTED BY SPOTTISWOODE AND CO.
NEW-STREET SQUARE